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HEATING AND VENTILATING

THE AIR CONDITIONING MONTHLY

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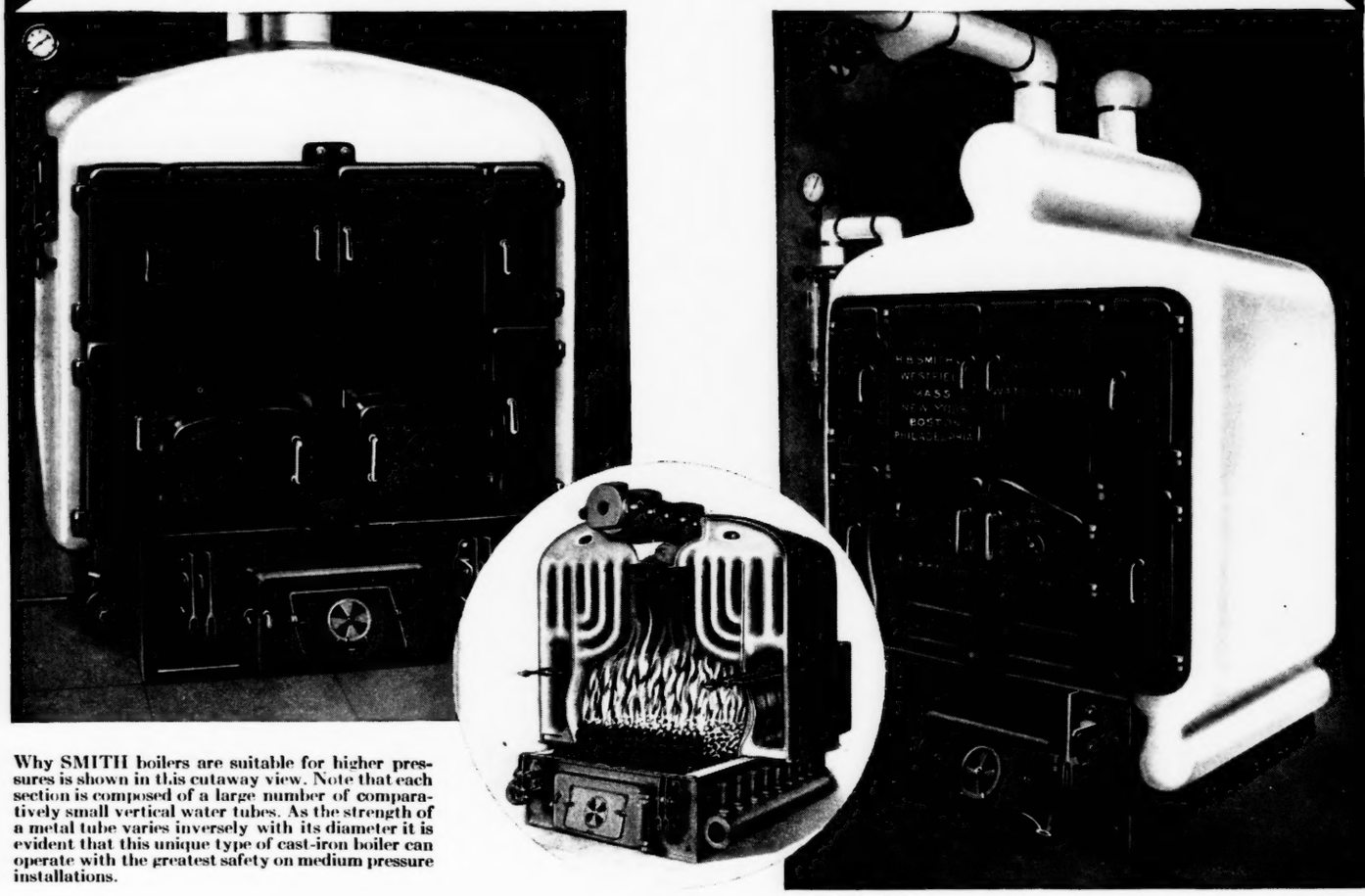
H. B. Smith BOILERS



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#34 Hy-Test	40 H.P.	50 H.P.	200 lbs.	50 lbs.
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BOSTON NEW YORK PHILADELPHIA

HEATING AND VENTILATING, *formerly*, HEATING & VENTILATING MAGAZINE, published monthly by THE INDUSTRIAL PRESS, 148 Lafayette Street, New York, N. Y., U.S.A. Subscription rates: United States and Canada, $2.00: Foreign, $3.00. Single copies, 30 cents. Vol. 40, No. 5 May, 1943. Entered as second-class matter, April 18, 1925, at the Post Office at New York, N. Y., under the act of March 3, 1879.

for . . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

HEATING AND VENTILATING

The Air Conditioning Monthly

PUBLISHER

THE INDUSTRIAL PRESS

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PUBLISHING INFORMATION

HEATING & VENTILATING is published monthly by the Industrial Press at 148 Lafayette Street, New York, N. Y. Western office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents.

ADVERTISING REPRESENTATIVES

Eastern Representative
ALGWYNNE COLLINS
148 Lafayette Street
New York, N. Y.

Western Representative
GEORGE G. TURNER
228 North La Salle Street
Chicago, Ill.

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THIS MONTH'S COVER

Castle Village, one of New York City's outstanding apartment house developments, has been converted to coal with 10 Skelly stokers installed in five separate boiler rooms. The general subject of oil to coal conversion is thoroughly discussed in Reference Section 10, beginning on page 43.

MEMBER

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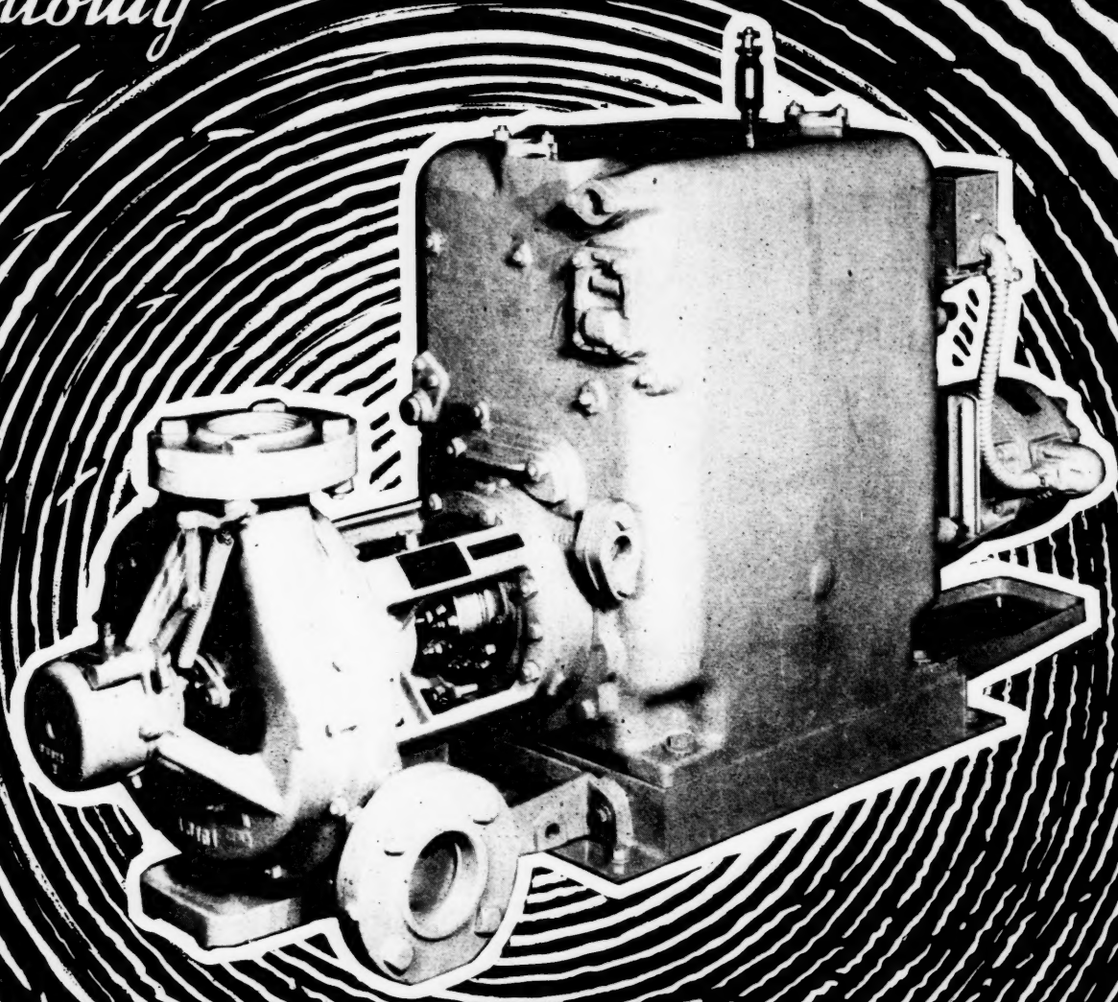
Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Fig. 1. Exterior view of the hospital officers' quarters at Great Lakes Naval Training Station as seen from lake side of courtway.

Naval Hospital Officers' Quarters

at Great Lakes Naval Training Station has compact hot water heating system designed with minimum use of critical materials. System described by Robert E. Hattis, Chicago consulting engineer, designer of the system.

ANYONE who has to design any part of a construction project these days needs a strong constitution to create a good job in spite of limitation orders and the dearth of materials. If it were not for our hearing about what Eddie Rickenbacker went through on a raft in the South Pacific, or what our other boys experienced in Guadalcanal or New Guinea, we might be given to a little self-pity.

However, after we take off our coats, roll up our sleeves, and get down to business, we are surprised at how good a system we can still plan if we work hard at it. An example of what the author believes is a good heating system, designed with the minimum use of critical materials, is the ten Officers Quarters recently completed at Great Lakes, Ill., and which is here briefly described.

Tucked away in a small corner of the Naval Hospital compound at Great Lakes Naval Training station was a plot of ground about 200 ft by 300 ft (exclusive of streets) available for officers' quarters, and sorely needed to accommodate the housing requirements of the much increased medical staff of this rapidly-growing Naval community. Walton and Kegley, architects, who were commissioned to design this job and retained the author as their mechanical engineer, made splendid use of this space by a U-shaped

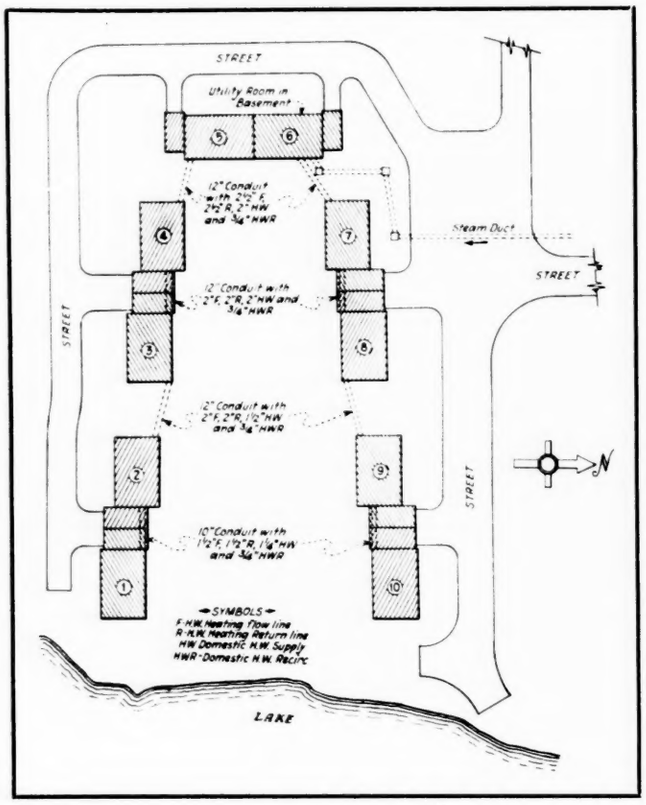

STREET
Utility Room in Basement
12" Conduit with 2½" F, 2½" R, 2" HW and ¾" HWR
Steam Duct
STREET
12" Conduit with 2" F, 2" R, 2" HW and ¾" HWR
STREET
12" Conduit with 2" F, 2" R, 1½" HW and ¾" HWR
STREET
10" Conduit with 1½" F, 1½" R, 1¼" HW and ¾" HWR
N
SYMBOLS
F-H.W. Heating Flow line
R-H.W. Heating Return line
HW-Domestic H.W. Supply
HWR-Domestic H.W. Recirc.
LAKE

Fig. 2. Plot plan of the officers' quarters showing location of the houses and of the connecting underground conduit. Note how, by offsetting, the architect has obtained a view of the lake from all houses.

grouping of ten single houses in five groups of two each, with each pair of houses linked together by adjoining garages. There are four houses on each side of the U and two on the closed end. The open end of the U looks out toward Lake Michigan, with each house and each building so offset as to have a direct view of the lake and access to its cool summer breezes. The accompanying plot plan illustrates how this rectangular lot with the narrow side adjacent to the lake was used to give a maximum view.

Each house, except the two at the closed end of the U, has six rooms and a bath. All are of two-story construction, with partial basements. Each pair is separated by two one-story, one-car garages, the roofs of which serve as porches. The end house has a common wall between each house with the garages on the ends. The architecture is modernized Georgian with exterior of mixed red colonial brick. The construction is brick-veneer, with 4 in. rock wool insulation in walls and roof, and a composition flat roof. Roofs and floors are wood, with concrete floors in garage and full basement. A shallow crawling space is located under the living room and the full basement, with laundry, is under the balance of the first floor. Living room, dining room, kitchen, entries, and stairways occupy the first floor. Three bedrooms and two baths occupy the second floor. The typical house floor plan shown illustrates the room arrangement.

Three utilities were needed to serve the heating system for this group of fine homes—steam from a central plant, electric power for pumps, and controls, and makeup water. All of these were brought into a basement utility room in the end building. A steam line, temporarily at 50 lb per sq in but eventually at 125 lb and a steam condensate return line were brought in underground in a rectangular concrete duct with precast concrete top. Water for all purposes was provided at adequate pressure. Primary 3-phase electricity at 60 cycles reduced by transformers in a basement vault, provides 110 volt current for lighting and 220 volt, 3-phase current for pump motors.

The 2½ in. high pressure steam service line in the utility room was equipped with a shut-off valve, a pressure gauge, and a trapped drip discharging into the top of a flash tank vented to atmosphere. From this, two branches were run, each equipped with pressure reducing valves to provide 5 lb per sq in, one serving the steam-storage domestic hot water heater, and the other serving a hot water convertor for a forced circulation hot water heating system. The flash tank discharges through a 5-ft water loop along with drips and condensate from the water heater and convertor, to the return line running to the condensation pump receiver which is also vented to atmosphere. A 1 hp motor-driven condensation pump, float-controlled, automatically discharges con-

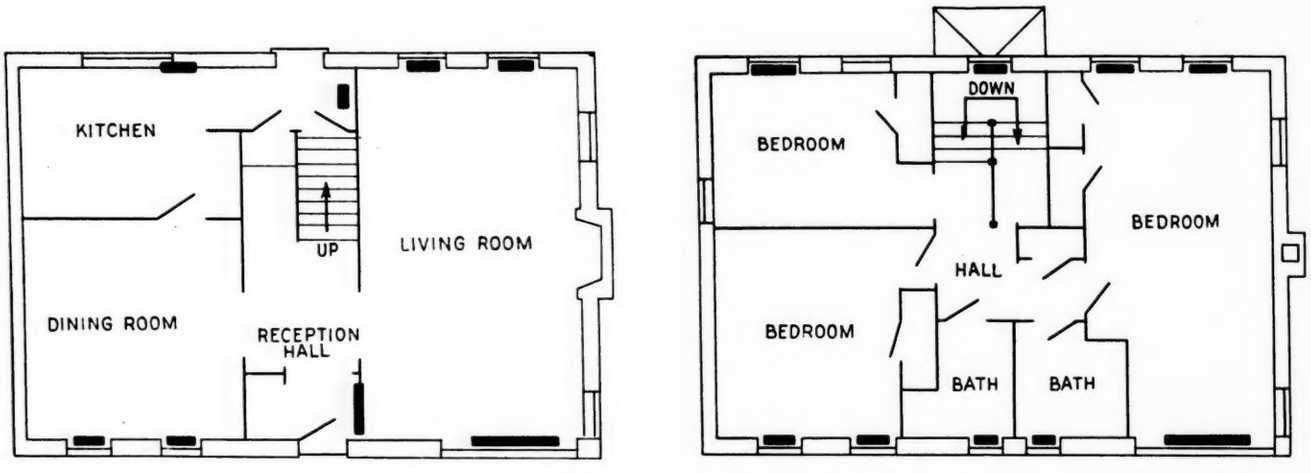


Fig. 3. Typical floor plans for one of the officers' houses.

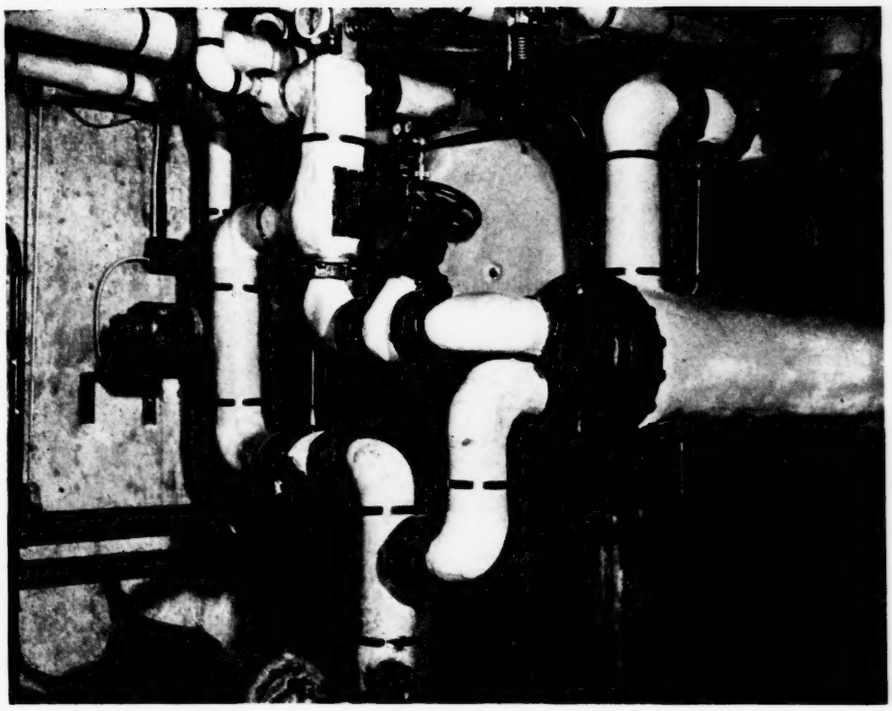


Fig. 4. Hot water converter in foreground with heating circulating pump on the floor. Domestic water storage heater in rear, with Bell & Gossett hot water circulating pump on wall bracket.

densate to the return line to the boiler house. A direct-acting steam regulating valve controls the temperature of the domestic hot water, and a hot water limit control in the recirculating line starts and stops a 1/6 hp Bell & Gossett circulating pump, keeping hot water on tap. Another direct-acting steam regulating valve controls the temperature of the water leaving the hot water convertor, maintaining about 220F.

The heating water is circulated by means of a 2 hp motor-driven pump in the return line, with a Sarcotherm three-way control valve regulating the amount of water going through or around the convertor to maintain varying flow-water temperatures as determined by a direct-acting differential control with two thermal bulbs, one in the flow-water line to the radiators and the other outdoors, shielded from the sun. This regulator has a dial switch which permits full heat, controlled head (with temperature adjustment), and no heat.

The heating circulating pump provides constant water circulation whenever the outdoor temperature is below 65F, except when shut off manually. A closed expansion tank in the utility room, connected to the return piping, takes care of expansion. Make-up water is provided automatically from the domestic water source through a pressure regulator to the expansion tank, which is also equipped with relief valves, water gauge glass, and means for venting and draining.

The hot water convertor, with steel shell containing the removable U-tube heat transfer element, and

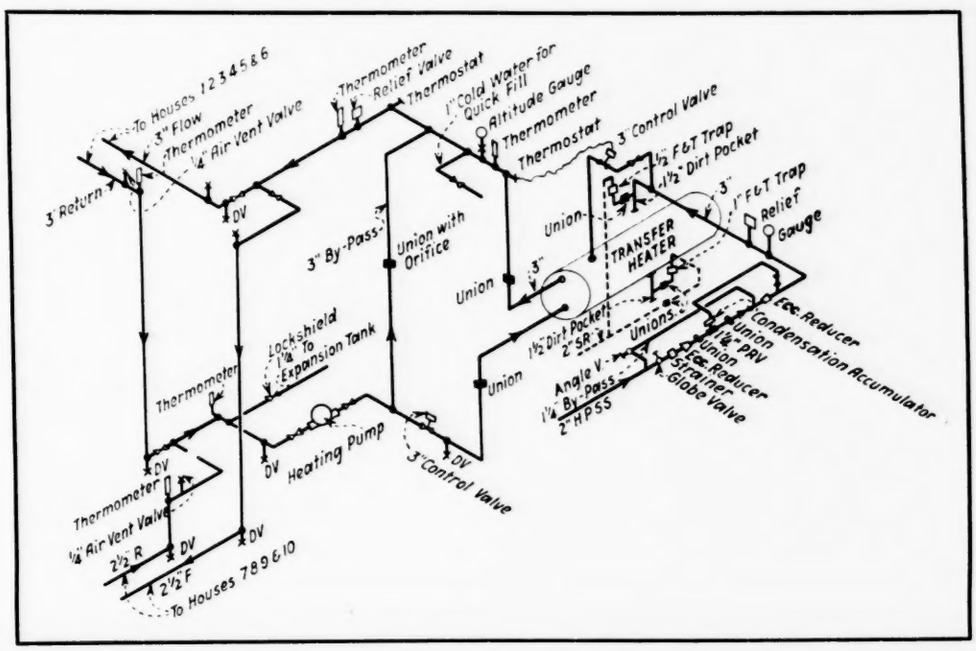


Fig. 5. Diagram of piping around the transfer heater.

with steam in the shell and water in the tubes, has a capacity, with 5 lb per sq in to heat 110 gpm of water from 190F to 215F, and has a water pressure drop of not over 2 lb per sq in. The accompanying diagram shows the connections to the convertor.

As noted, hot water for heating is circulated by two-pipe mains, run from the utility room at the bottom of the U extending to both sides, run along with domestic hot water pipes in Ric-wiL underground conduit between buildings and under garage floors, otherwise run suspended in crawl spaces and in full basement areas. To insure circulation in the mains, regardless of branch valve closure, a small valved cross-connection was run at the ends of each set of mains in the basement spaces of the houses at the tops of the U. The two-pipe main leaves the convertor at 3-in. size, splits into two 2½ in. branches, and ends at 1½ in. at the end of the line.

A valved 1¼-in. branch from the flow main in the basement of each house through a one-pipe main with Monoflo fittings serves the radiation in that house and connects to the return main through a regulating cock and shut-off valve, with an immersion thermometer to show the return water temperature leaving that house circuit. The shut-off valves permit insulation of the heating system of each house, with drainage provided by a valve at the lowest point. The one-pipe main serves the down-fed radiator in the laundry, and the up-fed radiators on the first and second floors. To conserve floor space, Sun-rad cast-iron radiant radiators were recessed in to the walls, in most cases under the windows. Cast-iron column radiators were used exposed only in the laundry and in the rear entry. No heat was provided in the garages.

For economy and for better heat control, asbestos air-cell insulation was applied on all steam lines, on the hot water convertor and storage water heater, on all hot water heating mains and branches and concealed risers to radiators, and on all domestic hot water and recirculating lines. Piping 2 in. and over was welded, while that 1½ in. and under was assembled with beaded cast iron 125 lb screwed fittings.

The heating system was designed to provide 70F indoors with —10F outdoors, with water in the radiators entering at 210F and leaving at 190F, using 200 Btu emission per sq ft of column radiator and 170 Btu emission per sq ft of recessed radiant radiation. Branches to radiators were ½ in. up to 36 sq ft and ¾ in. above that. Each radiator was equipped with a Sarco hot water radiator valve on the flow connection and a Sarco balancing ell on the return connection. Each radiator has a key-operated Dole automatic vent. The total radiation load and Btu emission is:

Type	Sq Ft	Btu per Hr.
Column radiation	813	170,730
Radiant radiation	4648	790,160
Total	5461	960,890

Prevent Fuel Waste for War

Various surveys have shown that combustion efficiency in the use of much of our coal output is too low and that effective effort would improve the use of at least 300,000,000 tons of coal per year 10 to 15%. Waste of fuel at this time gives definite help to our enemies, and all efforts should be made to prevent it. This country must conserve to the utmost its fuel resources—basic war power.

It is suggested to fuel users that the following recommendations be checked at their plants to determine to what extent they are being followed:

Preparation of Fuel—Keep the larger and smaller sizes of solid fuels well-mixed, if possible. Keep undesirable water out of the fuel;

Equipment—Clean, oil, and repair fuel-burning equipment, and maintain all automatic equipment and controls in proper adjustment. Keep boiler-room instruments properly calibrated and in good working order;

Combustion—Use no more air than is necessary to prevent too much unburned fuel, including smoke, from going out the stack. Study the flaming of the fire and its color. Watch for dark smokiness. Note fuel bed conditions as to thickness, holes, caking, clinkering, and hot flying particles. Take the temperature of the flue gases, and watch the carbon dioxide if instruments are available. Prevent undesirable unburned fuel in the refuse; reburn siftings and fly ash high in carbon;

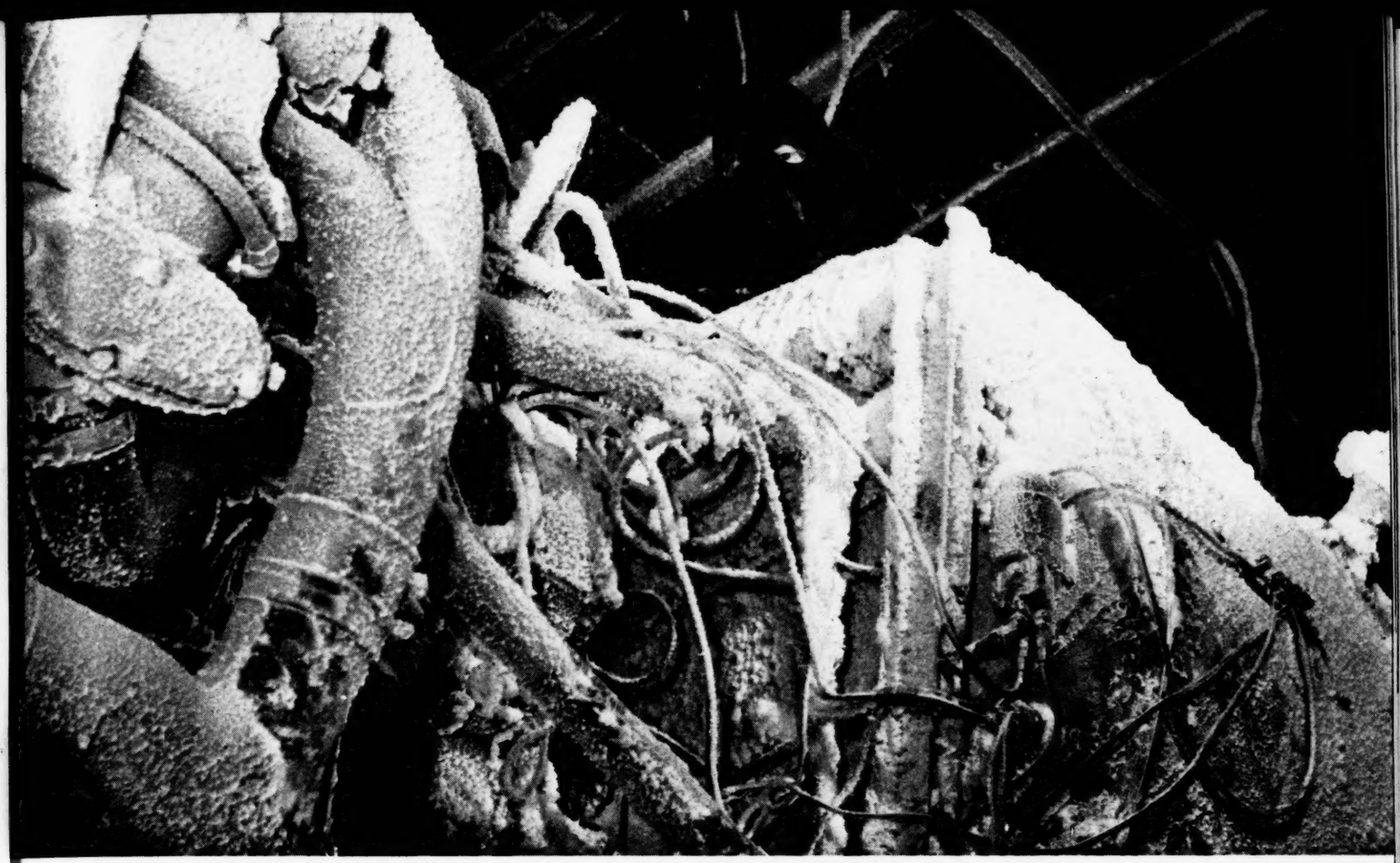
Drafts—Keep the draft or suction in the furnace and the wind-box pressure as low as possible. Maintain dampers and damper bearings carefully;

Use of Boilers—Arrange number of boilers on the line to use the least fuel, avoiding sustained high overloads as much as possible;

Boilers—Stop all undesirable air leaks in the boiler setting around headers, doors, peepholes, shells, drums, and soot blowers. Keep all heat transfer surfaces clean on *both* sides. Keep furnace brickwork and baffles in good repair, with baffles free from soot and fly-ash piles;

Blowing Down—Blow down boilers as little as possible;

Leaks and Insulation—Keep equipment and piping free from steam and water leaks. Insulate all possible hot surfaces to lower heat losses.—*J. F. Barkley, Chief, Division of Solid Fuels Utilization for War, Bureau of Mines.*



WRIGHT TESTS PLANE ENGINES AT STRATOSPHERE TEMPERATURES

ENGINEERS of the Wright Aeronautical Corporation, in collaboration with research workers of the Standard Oil Company, have created a polar climate in a New Jersey test cell to duplicate the cold weather problems inevitable when flight operations are carried on in arctic regions during wartime.

Beginning at 0F and then chilling the test cell 5F lower with each successive test until the cold room is 100F colder than outside, the engineers are using a 1700 hp Wright Cyclone to test new fuels, lubricants, batteries, magnetos, spark plugs and other equipment designed especially for cold weather.

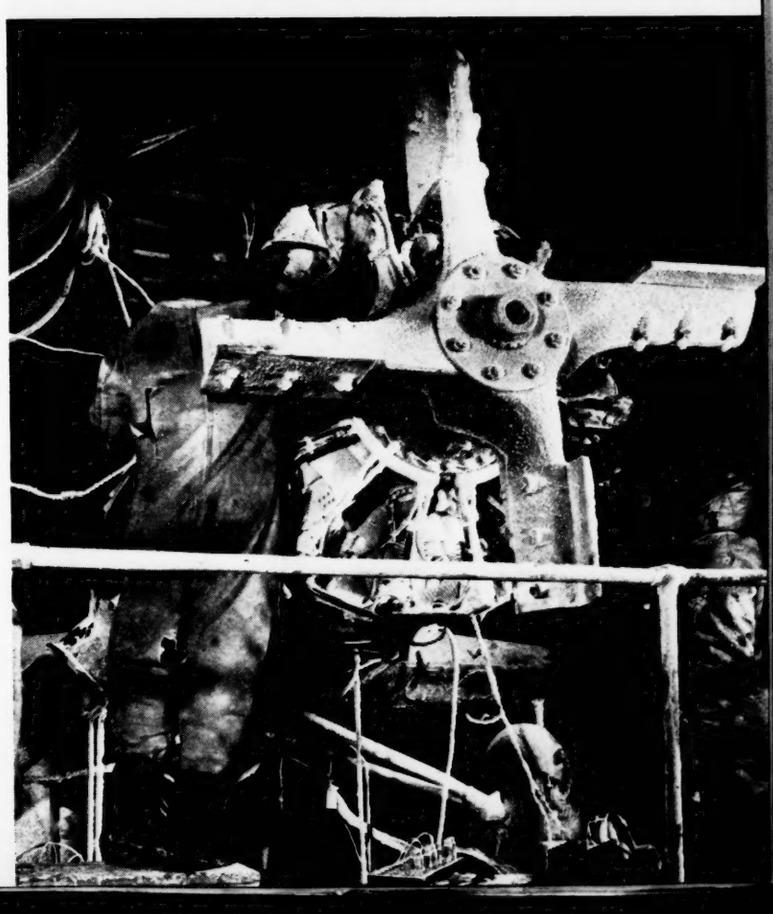
These tests duplicate the difficulty of operating from hangarless bases where temperatures of —60F can congeal lubricating oil to the consistency of glue, change gasoline into a lifeless fluid and rob batteries and magnetos of voltage. Even at bases with hangars, planes must be dispersed to make a scattered target against possible enemy bombing raids.

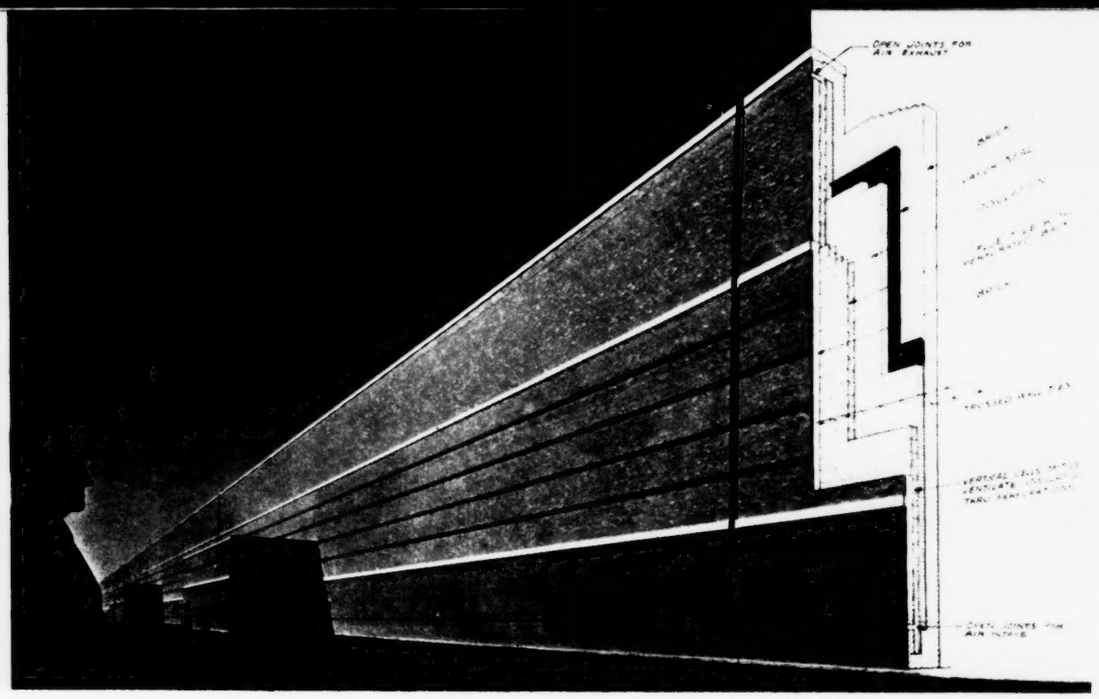
Since the temperature quickly drops to freezing and then to below zero as altitude increases, even in the tropics, the only problem that winter brings to the engine is that of getting started. Planes and pilots have the continual problem of cold, but once the engine starts, extreme cold — even the steady —67F degrees below zero of the stratosphere — is only incidental. Research is concentrated on starting.

The engineers wear fur-lined flying suits, boots, helmets and gloves, with a felt face mask added as extra protection.

(Above) This is not a beetle with frosted antenna but a test engineer of Wright Aeronautical Corp., peering over the top of a Wright Cyclone aircraft engine during a long series of experiments with the operations of such engines at sub-zero temperatures. These experiments are carried out in a New Jersey test cell under conditions simulating warplane operation.

(Below) Two heavily-dressed Wright engineers are shown making adjustments at sub-zero temperatures.





There are nearly two miles of windowless "breathing" walls like this in the new Oklahoma City aircraft assembly plant designed by The Austin Company for the U. S. Army Engineers. Douglas Aircraft Co., Inc., is already producing C-47 Skytrains in the plant, ground for which was broken just twelve months ago. Ventilation obtained by the use of ventilating tile with perforated back, a 4 in. mat of rock wool and a waterproof membrane vapor seal inside the wall.

Ventilated Wall Saves Steel in Walls of Douglas Aircraft Plant

C-47 SKYTRAINS are already coming off of a complete production line in the new Oklahoma City plant of Douglas Aircraft Co., Inc. An unusual feature of this plant is the nearly two miles of "breathing" walls.

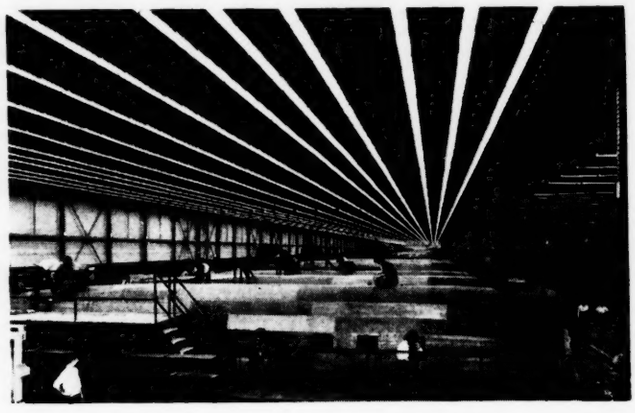
As Army engineers made their official inspection tour marking acceptance of the plant from The Austin Company, who designed it and managed the construction under their supervision, thousands of Douglas men and women already on the job for several months worked away without interruption on a seemingly endless line of transports and all the parts required to make them.

When the Army asked Austin engineers to design the Southwest's third huge heavy aircraft plant with the same controlled conditions provided in the first two, but with limited use of steel which made them possible, the idea of a breathing wall of masonry was born. The engineers designed a revolutionary brick wall over 50 ft in height, which is ventilated through open vertical joints in one course near the top and in two courses waist high near the bottom of the outer brick work.

Hollow ventilating tile serves as a flue through which air circulates vertically between these open joints. The tile has a perforated back which allows the 4 in. blanket of rock wool insulation to breathe, thereby preventing condensation and keeping it permanently dry. The wool is held in place by lightweight trussed wall ties which hold the many layers of the wall together and make it shatter resistant. This is the only steel in the entire wall. While only a fraction as thick, it has the same insulating value as an 80 inch brick wall. It has a roof of ferroglas for sound absorption, light reflection, as well as insulation.

While the new plant provides the same ideal working conditions and manufacturing facilities as the finest control conditioned plant designed before the need for metal conservation became apparent, it has only half the steel required in earlier plants.

The main building houses under one roof all of the facilities essential for manufacture and assembly of large two-motor transport planes identical with those which played an important role in the invasion of North Africa and have supplied our South Pacific bases with a continuous flow of ammunition, food, and reinforcements.



Interior of the Douglas Aircraft Co., Inc., windowless aircraft plant in Oklahoma.

HEATING and VENTILATING'S

REFERENCE SECTION

10

OIL *to* COAL *Conversion*

OIL-TO-COAL CONVERSION

In the interest of oil conservation in fuel-oil rationed states, both the War Production Board and the Office of Price Administration are facilitating the installation of equipment to burn coal to replace existing oil-burning plants wherever possible. However, the present policy of the Washington agencies involved is to place the greater emphasis of conversion on plants larger than domestic.

It is the objective of this Reference Section to provide the engineer not too familiar with coal-burning equipment or with conversion from oil with sufficient information on conversion to enable him to make an intelligent beginning with the project of changing over. For convenience the Section is divided into parts as follows: (1) How to Get a Stoker; (2) Stoker Markets; (3) Surveying the Job; (4) Chimneys; (5) Controls; (6) Sizing the Stoker; (7) Combustion; (8) Installation Problems; (9) Fuel Problems.

The first full winter of fuel-oil rationing is now behind us; in a few months another heating season will begin, and the matter of fuel oil availability will again be facing us. It is not too early to ponder on these questions: Will the new pipe lines offset tanker sinkings sufficiently to ease up on oil rationing next fall? Will the defeat of the Axis in Africa make possible greater use of Near East oil by our troops abroad, lessening the off-shore oil requirements along the Atlantic Coast? Have there been sufficient oil-to-coal conversions to enable still unconverted plants to remain on oil?

The answers to these questions are, as have been those to similar questions ever since the summer of 1941, confused, to say the least. For example, Petroleum Administrator Ickes has indicated that next winter's rationing will be as severe as that just experienced. On the other hand, Joseph Eastman, head of the Office of Defense Transportation, is optimistic on the possibility of easing up on oil rationing.

The present (April) policy in Washington is to urge the conversion of larger heating plants from oil to coal, with very little emphasis on domestic conversions.

Meanwhile a more or less violent controversy continues between the oil and solid fuel proponents. Briefly, this currently seems to revolve about (a) Whether or not the U. S. has sufficient oil reserves to continue her usual policies in the consumption of petroleum, and (b) Whether or not this lack of reserves, plus new uses for petroleum, may so raise the price of fuel oil after the war that oil will be too costly to use for heating.‡

Where a building owner or manager is being subjected to pressure from OPA to convert, the exact status of oil reserves and post-war oil costs are somewhat academic matters. He is practically compelled to convert or, as frequently happens, he wants to convert so that he will have reasonable assurance of getting fuel next winter. It would be advantageous to him to be able to foresee the situation as of next fall and as of subsequent periods; this just isn't possible.

This much, however, *is* known:

(1) A large number of buildings are under pressure in one form or another to convert from oil to coal;

(2) Of these plants, probably the majority could not be hand-fired, either due to manpower or size of installation; and

(3) Stokers are obtainable, in most cases, and economical in operation. Consequently, they offer the logical solution to the problem in a great many instances.

There is, however, an additional decision facing the owner or manager after he has decided to convert. Shall he purchase a low-cost stoker, install it as cheaply as possible, and tear it out after the war, or shall he consider the installation of the stoker to be permanent?

HEATING AND VENTILATING has no crystal ball; it doesn't know what will happen after the war. However, it does seem that:

(1) Even before the present emergency stokers were highly competitive with oil burners, particularly in the larger-than-domestic market;

(2) Much of the headway made by stokers in recent years has been due to economy of operation. The margin of advantage of one fuel over another was, generally speaking, small, either way;

(3) There seems to be no reason why conversion is an exception to the if - a - thing - is - worth - doing-it - is - worth - doing - right idea. Undoubtedly a careful study of certain buildings now on oil would indicate that conversion to stokers would be sound even aside from the present situation. At any rate, a thorough study should be made of the case in point, without too much regard for propaganda on either side.

If the decision is, for one reason or another, in favor of the stoker, then read the suggestions which follow. In addition, attention is called to the brief discussion of possible use of waste heat from processes in factories, presented at the end of this section.

‡An indication of the confusion confronting those attempting to analyze the situation is found in (for example) two statements: The American Petroleum Institute calculates oil reserves at 20 billion barrels as compared with 15.5 billion in 1937. On the other hand, Dr. A. C. Fieldner of the Bureau of Mines, in an April 22 speech in Chicago, said: "Expected higher prices for fuel oil will tend to discourage new installations using this fuel. The greatest concern for the future supply of oil is the continuing decline during the past four years in the discovery of new fields. This calls for a marked increase in exploration to keep current withdrawals from reaching the point where total recovery is diminished."

HOW TO GET A STOKER

Manufacture of small (Class B) stokers burning up to 61 lb of coal per hour was discontinued Sept. 30, 1942 by order of WPB (L-75). A limited number of these stokers in the hands of manufacturers and distributors are being sold, in practically every instance to replace oil burners in the thirty states subject to oil rationing regulations. Class B stokers, as long as available, can be sold in the fuel-oil rationed area

n OF HEATING PLANTS

without priorities where they replace oil; they may be sold anywhere in the U. S. to replace handfired jobs, provided the cost does not exceed $200 for the complete installation. Where the cost runs higher than that amount, special permission is required from the Washington office, Plumbing and Heating Div., War Production Board. Many urgent appeals have been made to Washington for a relaxation of the restrictions, including permission to resume manufacture of small stokers, but at least up to the end of April manufacture of Class B stokers is still banned.

On the other hand, manufacture of commercial and industrial Class A stokers[1] was never stopped and production is now steadily increasing. It is anticipated that between 35,000 and 50,000 Class A stokers will be installed in 1943, depending on demand. If the demand runs higher, permission to manufacture will probably run higher also.

Class A stokers are sold after application to the local district office of WPB on Form PD-668, as revised. The revised form, on its back, provides for the listing of any supplementary materials, parts, or other equipment without which the stoker applied for could not be installed. The purpose is to facilitate the approvals by concentrating as much essential materials as possible on a single, compact form. Previously the extra materials were listed on a separate form. PD-668 may include supplies needed for the particular boiler mentioned in the application, such as controls, damper regulators, steel supports, boiler water feeders, low water fuel cut-offs, and other necessary equipment. The stoker applications are approved or rejected according to the conditions in each case, with WPB willing to ease restrictions as much as possible for every worthy case. It is realized that everybody cannot arrange for handfiring, and that stokers provide an outlet for large quantities of coal in the smaller sizes, particularly anthracite. Conserving of fuel oil is, naturally, the primary objective.

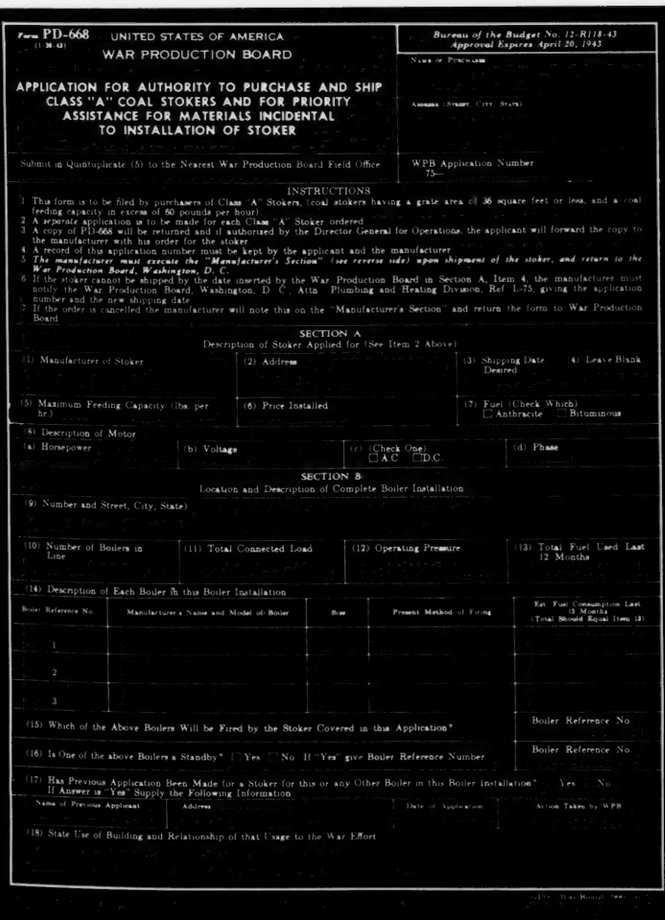
Where the stoker conversions run over $5,000 in total cost, applications are referred to WPB headquarters in Washington. It appears that the average cost for the medium size commercial job is anywhere from $1,000 to $2,000. For stokers larger than Class A, and total cost under $5,000, application should be filed for a priority rating on Form PD-333A. But with or without a stoker, PD-333A should be used for any extra supplies needed for a PD-668 stoker, such as lumber, ash hoists, conveyers, chutes, sheet metal, forced draft or induced draft blowers, electric wiring, hot water storage tank, hot water heater, etc. When the cost of the job runs in excess of $5,000, Form PD-681 is used.

Five copies of the applications should be filed with the nearest field or regional office of WPB in all instances. Some dealers have been filing only four, and this has caused difficulties and delays. Reserve supplies of PD-668 form in quantities may be secured from Marc G. Bluth, secretary, Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago, at the nominal cost of $2.10 per thousand, postage or express charges prepaid. Distributors, contractors and salesmen will be requiring many of these forms for months to come and may lose business if they do not have them on hand.

When PD-668 applications have

[1] A Class A stoker burns over 60 lb of coal per hr but has a grate area less than 36 sq ft.

Fig. 1. The War Production Board's Form PD-668, showing front and back of the sheet, and used when applying for authority to purchase a Class A stoker and incidental materials.



Form PD-668 (1-28-43) UNITED STATES OF AMERICA
WAR PRODUCTION BOARD

Bureau of the Budget No. 12-R118.43
Approval Expires April 30, 1943

APPLICATION FOR AUTHORITY TO PURCHASE AND SHIP CLASS "A" COAL STOKERS AND FOR PRIORITY ASSISTANCE FOR MATERIALS INCIDENTAL TO INSTALLATION OF STOKER

Name of Purchaser

Address (Street, City, State)

Submit in Quintuplicate (5) to the Nearest War Production Board Field Office

WPB Application Number 75—

INSTRUCTIONS

1 This form is to be filed by purchasers of Class "A" Stokers, (coal stokers having a grate area of 36 square feet or less, and a coal feeding capacity in excess of 60 pounds per hour).
2 A *separate* application is to be made for each Class "A" Stoker ordered.
3 A copy of PD-668 will be returned and if authorized by the Director General for Operations, the applicant will forward the copy to the manufacturer with his order for the stoker.
4 A record of this application number must be kept by the applicant and the manufacturer.
5 *The manufacturer must execute the "Manufacturer's Section" (see reverse side) upon shipment of the stoker, and return to the War Production Board, Washington, D. C.*
6 If the stoker cannot be shipped by the date inserted by the War Production Board in Section A, Item 4, the manufacturer must notify the War Production Board, Washington, D. C., Attn: Plumbing and Heating Division, Ref. L-75, giving the application number and the new shipping date.
7 If the order is cancelled the manufacturer will note this on the "Manufacturer's Section" and return the form to War Production Board.

SECTION A
Description of Stoker Applied for (See Item 2 Above)

(1) Manufacturer of Stoker | (2) Address | (3) Shipping Date Desired | (4) Leave Blank

(5) Maximum Feeding Capacity (lbs. per hr.) | (6) Price Installed | (7) Fuel (Check Which) ☐ Anthracite ☐ Bituminous

(8) Description of Motor
(a) Horsepower | (b) Voltage | (c) (Check One) ☐ A.C. ☐ D.C. | (d) Phase

SECTION B
Location and Description of Complete Boiler Installation

(9) Number and Street, City, State)

(10) Number of Boilers in Line | (11) Total Connected Load | (12) Operating Pressure | (13) Total Fuel Used Last 12 Months

(14) Description of Each Boiler in this Boiler Installation

Boiler Reference No.	Manufacturer's Name and Model of Boiler	Size	Present Method of Firing	Est. Fuel Consumption Last 12 Months (Total Should Equal Item 13)
1				
2				
3				

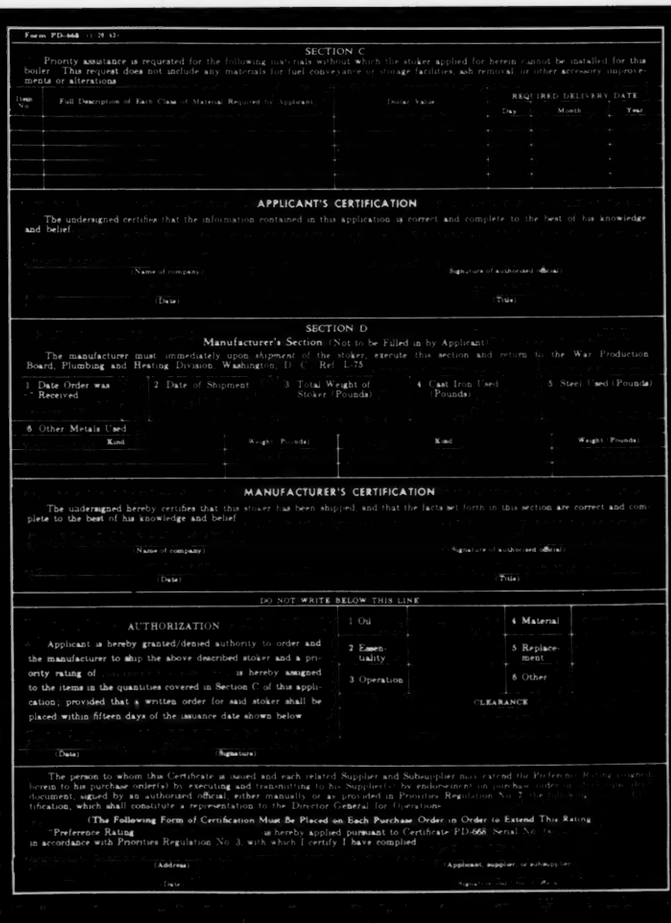
(15) Which of the Above Boilers Will be Fired by the Stoker Covered in this Application* Boiler Reference No.

(16) Is One of the above Boilers a Standby* ☐ Yes ☐ No. If "Yes" give Boiler Reference Number Boiler Reference No.

(17) Has Previous Application Been Made for a Stoker for this or any Other Boiler in this Boiler Installation* ☐ Yes ☐ No
If Answer is "Yes" Supply the Following Information:

Name of Previous Applicant	Address	Date of Application	Action Taken by WPB

(18) State Use of Building and Relationship of that Usage to the War Effort



Form PD-668 (1-28-43)

SECTION C

Priority assistance is requested for the following materials without which the stoker applied for herein cannot be installed for this boiler. This request does not include any materials for fuel conveyance or storage facilities, ash removal, or other accessory improvements or alterations.

Item No.	Full Description of Each Class of Material Required by Applicant	Dollar Value	REQUIRED DELIVERY DATE Day	Month	Year

APPLICANT'S CERTIFICATION

The undersigned certifies that the information contained in this application is correct and complete to the best of his knowledge and belief.

(Name of company) (Signature of authorized official)

(Date) (Title)

SECTION D
Manufacturer's Section—(Not to be Filled in by Applicant)

The manufacturer must, immediately upon shipment of the stoker, execute this section and return to the War Production Board, Plumbing and Heating Division, Washington, D. C., Ref. L-75.

1 Date Order was Received | 2 Date of Shipment | 3 Total Weight of Stoker (Pounds) | 4 Cast Iron Used (Pounds) | 5 Steel Used (Pounds)

6 Other Metals Used

Kind	Weight (Pounds)	Kind	Weight (Pounds)

MANUFACTURER'S CERTIFICATION

The undersigned hereby certifies that this stoker has been shipped, and that the facts set forth in this section are correct and complete to the best of his knowledge and belief.

(Name of company) (Signature of authorized official)

(Date) (Title)

DO NOT WRITE BELOW THIS LINE

AUTHORIZATION

Applicant is hereby granted/denied authority to order and the manufacturer to ship the above described stoker and a priority rating of ____ is hereby assigned to the items in the quantities covered in Section C of this application; provided that a written order for said stoker shall be placed within fifteen days of the issuance date shown below.

1 Oil | 2 Essentiality | 3 Operation | 4 Material | 5 Replacement | 6 Other

CLEARANCE

(Date) (Signature)

The person to whom this Certificate is issued and each related Supplier and Subsupplier must extend the Preference Rating covered herein to his purchase order(s) by executing and transmitting to his Supplier(s) by endorsement on purchase order or other document, signed by an authorized official, either manually or as provided in Priorities Regulation No. 7, the following certification, which shall constitute a representation to the Director General for Operations:

(The Following Form of Certification Must Be Placed on Each Purchase Order in Order to Extend This Rating:

"Preference Rating ____ is hereby applied pursuant to Certificate PD-668 Serial No. ____ in accordance with Priorities Regulation No. 3, with which I certify I have complied.

(Address) (Applicant, supplier or subsupplier)

Date Signature and title of official)

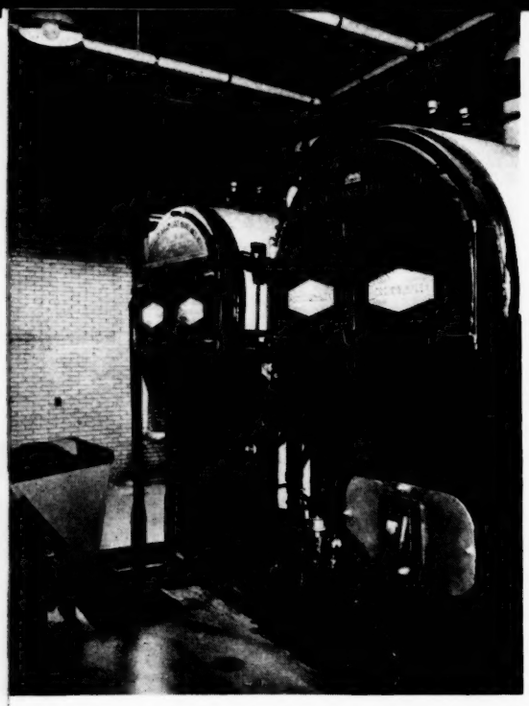


Fig. 2. A Holcomb & Hoke No. 50 Firetender stoker installed under a Heggie-Simplex return tubular boiler in the Indianapolis office of the American United Life Insurance building. In converting from oil to coal this building installed one stoker to carry the base load but left the other boiler on oil to carry additional fluctuating loads.

been approved, the notices from WPB go to the building or plant owners who are expected to pass the order on to the manufacturer or dealer within 15 days (if over 15 days the application is void). If the local distributor wishes some notice of the date of issuance of the approval, one WPB office suggests that he include a filled-in self-addressed postal card having a blank space for the date. This gives him an opportunity to keep in touch with the order.

The purchaser of a Class A stoker, designated as a coal stoker having a live grate area of 36 sq ft or less, and a feeding capacity of 60 lb per hour, is required to file a separate application for each stoker ordered.[2] When the PD-668 has been approved, the purchaser sends his authorization to the distributor or manufacturer of the stoker. Upon shipment of the stoker, the manufacturer executes the Manufacturer's Section on the reverse side of the form and returns the copy to WPB.

A separate PD-668 is filed for each Class A stoker even where there may be a battery of two or more in the plant. Where there are two or more boilers and only one stoker is being applied for, each boiler is described as to make and size and fuel oil consumed in a heating season, at the same time stating the particular boiler for which the stoker is intended.

Form PD-668 asks whether there had been a previous application for a stoker for the same installation and what action had been taken by WPB. Building owners and stoker men should keep in mind that old applications may be renewed even if they had not been previously approved. In fact, some WPB offices have reviewed old applications on their own initiative and notified owners and dealers of any change in the original decision. There has been a change in the rigidity of WPB limitations as regards the larger stokers, apparently due to demand.

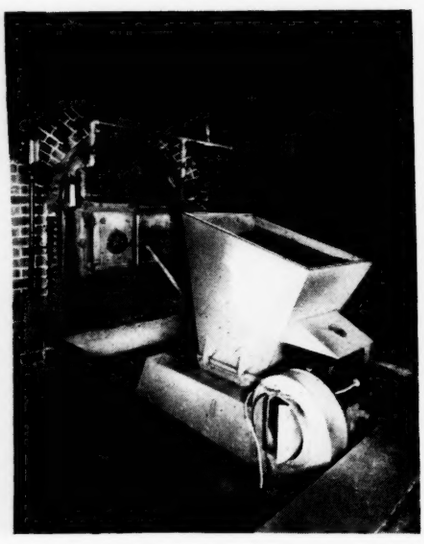
When a PD-668 application has been authorized, it is given a serial number and a priority rating for the extra materials listed on it. The purchaser and each related supplier and sub-supplier may then extend the assigned rating on all purchase orders for the job by placing on them the certification statement and serial number as specified on the approved PD-668 application.

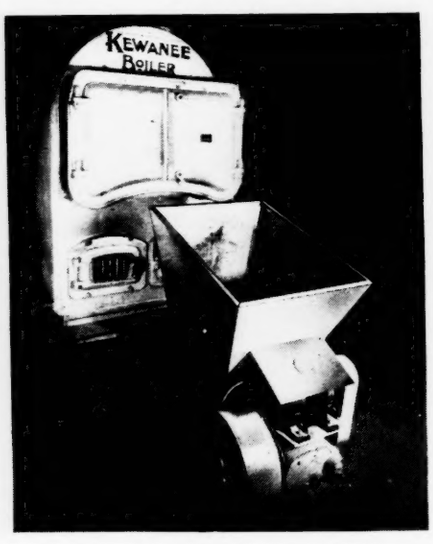
The delivery of a Class A stoker may be from the warehouse of a local distributor rather than direct from the factory. This is because WPB has permitted some carload shipments in regions where the orders were accumulating; however, the local distributor must account in each instance on a returned PD-668 form for the final delivery of the stoker to the designated purchaser.

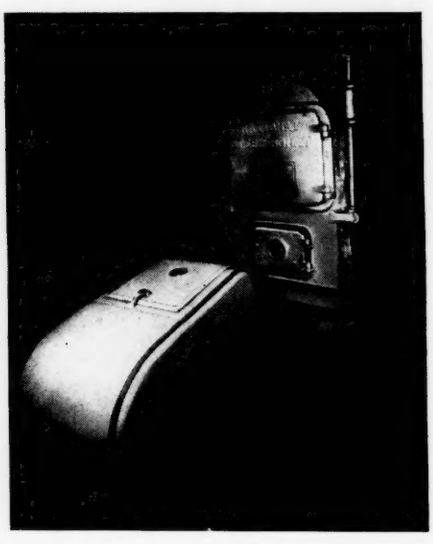
All applications for authorization of Class A stoker installations are checked by competent WPB engineers who will point out, if it is necessary, the opportunities to conserve any critical materials. These engineers are also familiar with average prices and each applicant is asked to state the actual cost of proposed installations or materials. Approvals have been held up in instances where the anticipated costs were apparently overstated. Overstatement of alleged costs invites suspicion that the installers may have in mind the idea of securing on one authorization more supplies than actually required for the stated job and then hoarding the surplus. Thus, WPB engineers or investigators may at times go direct to suppliers to check on certain figures. As a rule, however, PD-668 applications when accurately made out are promptly cleared through WPB with every possible co-operation on the part of that agency.

Class A stokers should be installed without delay; such a project is not something to be put off until the

[2] On April 13, 1943, WPB issued a clarification of its L-75 definition of a Class A stoker, the interpretation reading as follows: "'Class A Coal Stoker' means any coal stoker which has a grate area of 36 sq ft or less, and a coal feeding capacity in excess of 60 lb per hour. 'Grate area' as used in said paragraph means only the live grate. Side dump plates are not a part of the grate area. 'Coal feeding capacity' as used in said paragraph means the coal feeding capacity performance of a stoker with a commonly used stoker coal."







Three installations of Fireguard stokers made by Peerless Mfg. Corp., Louisville. Fig. 3. (left) Installation in a Buena Avenue, Chicago, apartment house. Fig. 4. (center) Installation in the Glen View school, Glen View, Ill. Fig. 5. (right) Installation in the building of the L. P. Friestedt Company, Chicago.

next heating season approaches. Stoker men reeport the most pressing demand for Class A stokers in history. Some manufacturers in the line are exceeding all previous production records. In the meantime the stoker industry must have a steady stream of orders flowing against the tide of priorities made available to other important industries. As matters stand early in 1943, no one can give assurances to the stoker buyer who delays his order that either men or materials will be available to him when he finally comes to his decision.

One executive of a WPB regional office has recommended that it would be well for the stoker industry to sell stokers strictly on their merits as efficient and economical automatic heating equipment, rather than as a substitute for other firing apparatus. WPB observes public reactions very carefully. It apparently welcomes a cheerful purchaser of stoker equipment. The point is that some prospective stoker purchasers have come to WPB regional offices to make inquiries and appeared to be exceedingly reluctant on the question of heating plant conversions. Most of the assurances they seemed to be seeking, it was said, might well have been conveyed to them by stoker representatives in advance.

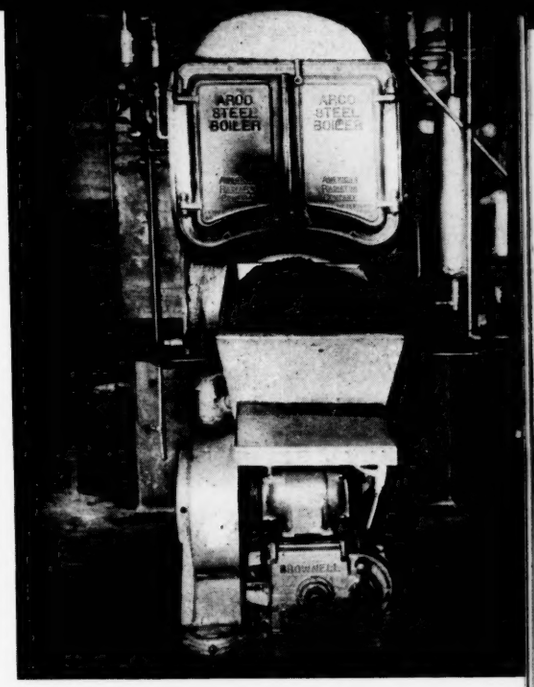


Fig. 6. The largest automatic garage in the United States has been converted from oil to coal and a Brownell underfeed stoker installed. The stoker is equipped with an air volume control to keep the coal bed even so that the soft coal will burn properly.

STOKER MARKETS

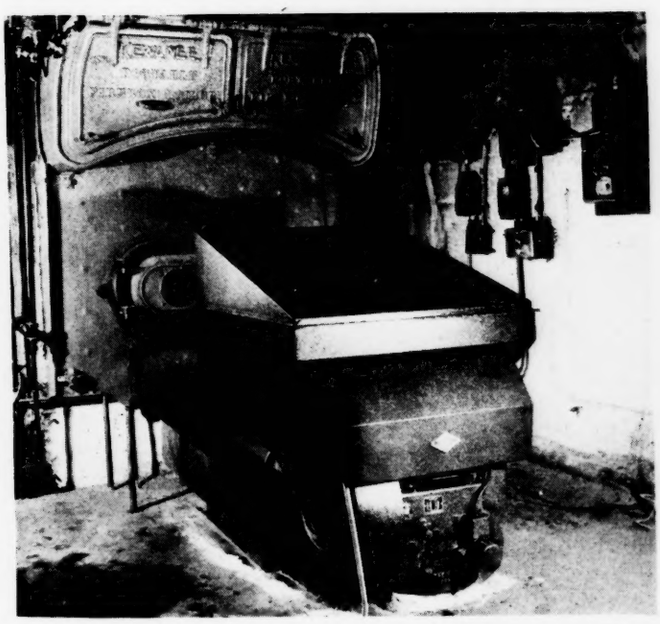
Stokers used in heating and smaller industrial work are generally of the underfeed type, complete motor-driven units embracing standby hopper, feed worm or ram, combustion air fan and fire retort. These can be further classified as of the underfeed side cleaning type; or the underfeed rear cleaning type. Other types include the overfeed flat grate and overfeed inclined grate type.

Some stokers come equipped for feeding coal direct from the bin to the retort. In instances where it may be impractical to install the usual hopper or binfeed stoker, for lack of floor area or narrowness of the fire chamber, some installations are being made of the overfeed pneumatic spreader type. Aside from any question of which stoker may be best, there is a type best suited to a given set of boiler and heat load conditions. The single retort underfeed stoker seems just right for the steel firebox boiler, but with the probability of a dual retort for larger installations and special load characteristics. Dual retort stokers are generally installed in high pressure jobs for larger commercial or industrial heating requirements and for smaller power jobs, in boilers of large furnace space and running up to 500 hp or more.

Coal is burned more efficiently with a stoker than by hand firing; the stoker has positive controls, provides a uniform and easily regulated feed rate, gives better distribution in the fuel bed and a suitable supply of air for combustion.

Stokers burn bituminous coal, anthracite or lignite. According to Marc G. Bluth, secretary, Stoker Manufacturers Association, every producing field today is preparing more coal for stoker use than ever before.

The enormous number of stokers now in use are estimated to consume in excess of a hundred million tons of coal per year. The mechanical coal stoker has found its most productive market in the industrial centers of the United States where bituminous coal, and anthracite to a certain extent, is consumed in great quantities for both industrial and space heating purposes. The stoker industry naturally concentrated in regions where abundant supplies of lower cost bituminous coal made it the logical fuel for most purposes. Surveys made by the Stoker Manufacturers Association in 1941 showed



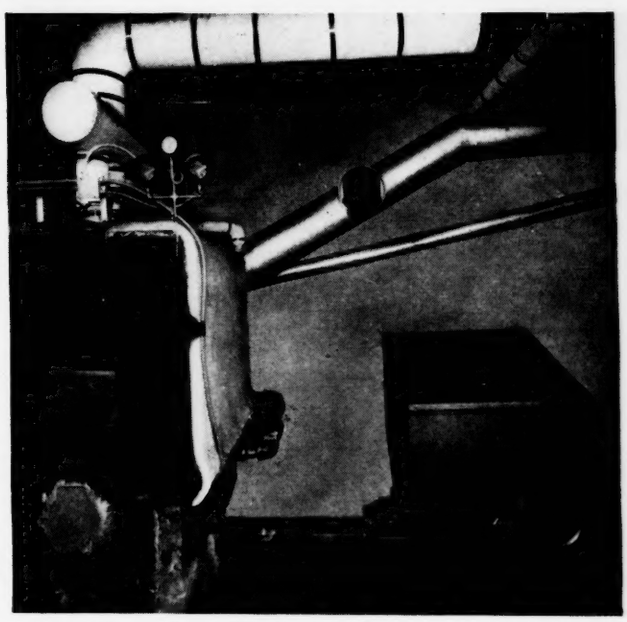


Fig. 7. (Left) 42,000 gal of oil were used last heating season in this heating plant of St. Mathias school and church, Chicago, in which a Will-Burt stoker has now been installed. Fig. 8. (Right) This Will-Burt stoker has been installed in the side of a Burnham boiler in the heating plant of a Toledo Elks Lodge.

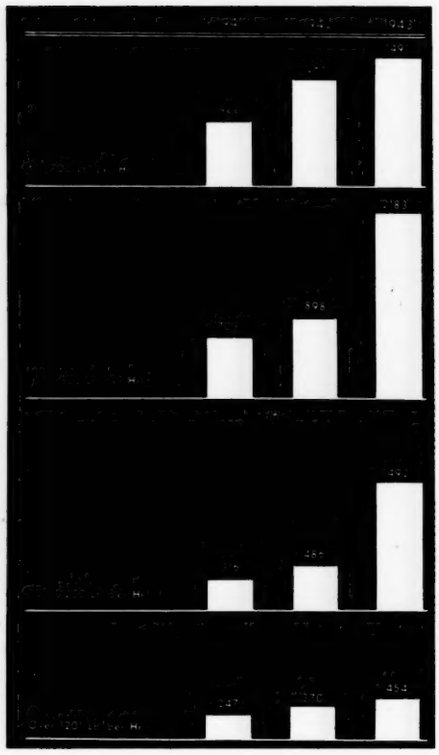


Fig. 9. Trends in stoker sales. The numbers adjacent to the bars indicate the number of stokers sold in four different categories during the first quarter of 1941, 1942 and 1943. Figures are not given for the Up to 61 lb per Hr group because production of these is banned.

that the industrial states of Illinois, Indiana, Michigan, Wisconsin, Ohio and Pennsylvania accounted for a major portion of stoker installations. Stoker installations will be found, however, in all states which use coal, with steadily increasing numbers of jobs along the Atlantic coast and in New England.

Stokers use local coals and provide an efficient means of consuming them, supplying the maximum amount of steam or heat in thousands of plants producing vital war equipment or materials, as well as in Army and Navy barracks, air fields, hospitals, laundries and power plants. The stoker does the firing job better than the most efficient human fireman and will burn low-grade coals more efficiently than by any other method not requiring processing of the coal.

Stokers make a big contribution in the saving of manpower. They save thousands of man-hours daily by reducing the labor necessary to operate great numbers of heating, power and processing plants, releasing this manpower for other essential work. At the same time boiler room personnel is usually released part time to attend to regular maintenance work or other duties.

Stokers frequently get greater steam output from boiler plants, developing 25 to 50% more steam than by handfiring, so that two stoker-fired boilers may do the work which otherwise would require three. The plants can therefore operate at greater capacity during the war emergency and without the delays incident to new boiler installations. Much critical material in the way of boiler plate steel and tubes may be saved where smaller boilers are used because of the increased capacity due to stokers.

The present markets for stokers have been nicely outlined by Claude A. Potts, vice-president, U. S. Machine Corp. According to Mr. Potts, "It is not possible to make an accurate list of heating plants that should or should not be converted. However, it is not difficult to decide generally what types of plants are important to the war effort. For example, I would place the following plants as being very essential to the war effort and should not be without heat: (1) Plants engaged 100% in producing war materials; (2) plants producing food stuffs; (3) buildings housing fire departments and police departments; (4) hospitals; (5) transportation facilities; (6) utility and communication facilities.

"Next in importance, I would classify the following types of buildings or plants: (1) apartment houses; (2) schools; (3) public buildings; (4) stores selling essential merchandise; (5) manufacturers of essential civilian goods.

"Next in importance, I would place buildings of the following types: (1) churches; (2) theaters; (3) retailers of non-essential civilian goods; (4) garages; (5) manufacturers of non-essential goods.

"We can classify other buildings and plants as being in a less essential or even non-essential group so far as the war effort is concerned. Such a group would be: (1) private clubs; (2) pool rooms; (3) night clubs; (4) greenhouses growing flowers; (5) retail stores of non-essential commodities.

"The above examples are given as a guide and not as an official list of plants or firms that can get stoker applications approved. The decision on approvals naturally rests with the War Production Board. Certainly we should direct our efforts in selling to the plants that are definitely most important to the war effort.

"Because all materials and production facilities are critical, the War Production Board wants plants that can be hand-fired satisfactorily to be hand-fired. There are thousands of installations where hand-firing will not be satisfactory. For instance, any one of the following reasons might prevail: (1) grates not available for converting to hand-firing; (2) physical location of boiler makes hand-firing impractical; (3) load of boiler is greater than boiler output when hand-fired; (4) uniform temperatures are required and can only be maintained with automatic firing equipment; (5) no satisfactory way to install grates.

"If any one or more of the above conditions prevail, it is probable that the only solution to the conversion problem is the application of a stoker."

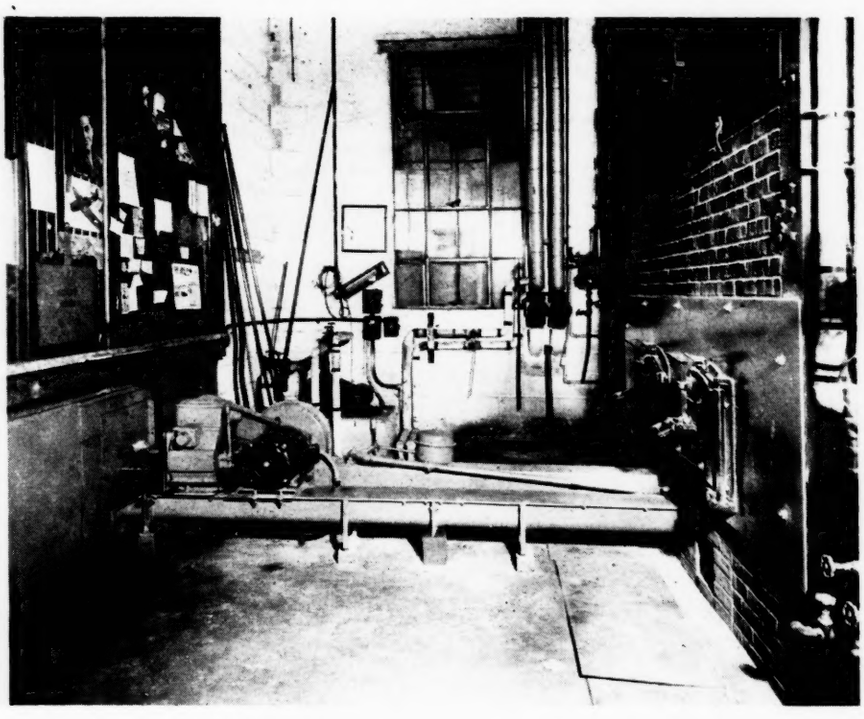


Fig. 10. Manual coal handling is eliminated in this bunker feed type stoker with the bunker located outside of the boiler room. This installation, by Iron Fireman, is in the plant of a plastics company in New Brunswick, N. J.

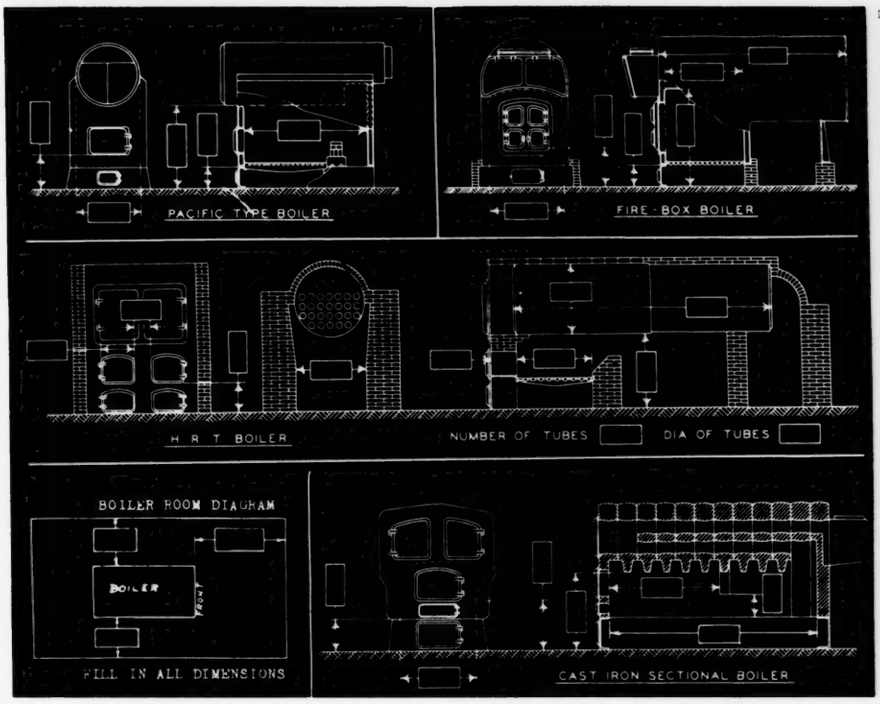


Fig. 11. Part of a survey sheet as used by field engineers and contractors who handle Gehl Bros. stokers. Accurate records are facilitated by leaving designated spaces as shown on the survey sheets so that important dimensions of various boilers as found may be entered without effort.

SURVEYING THE JOB

The six suggested points which follow, summarizing the steps in making the survey, are those of A. J. Mark, service engineer, Link-Belt Co. The client's plant or building should be visited by one competent to determine what present critical materials in the job may be used again in the stoker conversion. The regular steps in addition, when making the engineering survey, are:

(1) Sketch the boiler room plan, showing location of boilers, chimney, proposed coal bin, storage space, door and window openings. Give distances from boiler to existing walls. Note obstructions, equipments, floor drains, sump pumps, etc.;

(2) Necessary boiler data for identification—name and number, outside and inside measurements, number and diameter of tubes or flues. Find out the quantity of oil consumed per year, also quantity consumed per peak hour. Obtain the connected load on the boiler, and any other information necessary in sizing the stoker properly;

(3) Examine fire brick walls to determine if they are again usable. Do not jeopardize operation of stoker if required dimensions do not exist, even if the brickwork is in usable condition. Keep in mind that proper installation is the success of the stoker;

(4) If pit is deemed necessary, hold it to minimum required for the correct furnace volume. In many cases this will make it possible to use existing boiler firedoors for cleaning fires and obviate need for additional fire doors and new front plate. If new clinker doors must be installed, see if existing front plate can be used;

(5) Examine the electric wiring and controls to determine what can be salvaged and used with the stoker and, where feasible, recommend control set-up to improve stoker operation and efficiency; and

(6) Based on the foregoing information, size the stoker. Then a proposal may be submitted to the purchaser and he can be told what critical materials are being saved. With this full information, the result is a good stoker installation, high efficiency operation, and a satisfied customer.

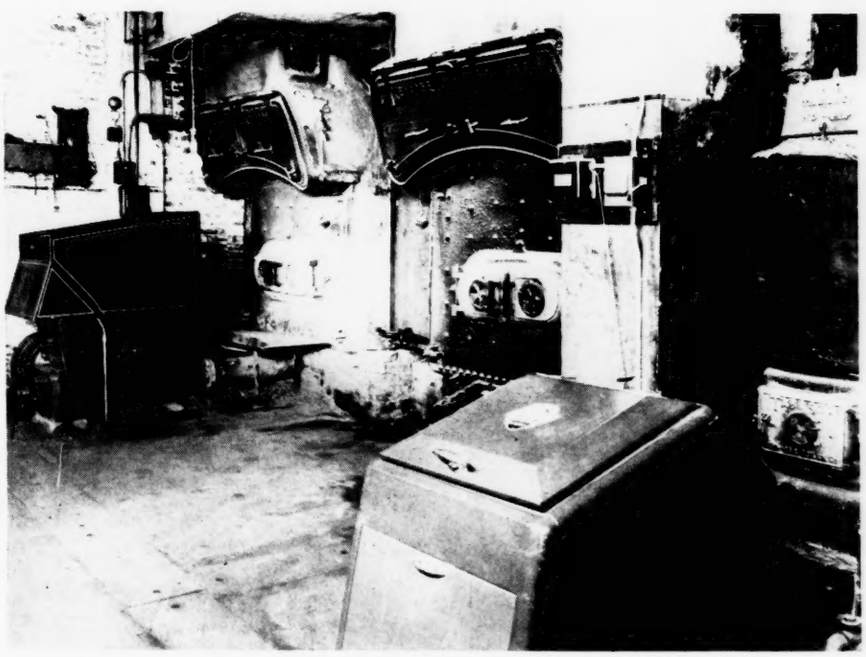


Fig. 12. Installations of Freeman stokers made by the Illinois Iron & Bolt Co. in the boiler room of the American Radiator & Standard Sanitary Corporation's building in Chicago. The installation at the left is in the Kewanee boiler while the one in the foreground serves the Tabasco service water heater. Both boilers were formerly oil-fired. The heating boiler in the center remains on oil for standby.

The question of available space is of outstanding importance when the project is being surveyed for the first time. Available space means space for the stoker itself, bunker space for coal, as well as that for some form of conveyer if the coal must be stored some distance away. The frequent difficulty, as stoker men in the field report, is a serious lack of boiler room space.

On the other hand, boilers which were properly equipped for fuel oil burners will generally have sufficient combustion space and flame clearance for bituminous coal. In all probability the oil burner installation was competently engineered, so that it should not be necessary to make any serious heating system improvements. The survey, however, embraces that question, too. However, assuming that the main service of the plant is to supply heat, and the owners report that the heating has been satisfactory, the questions then are the convertibility of the boilers, working space for the stokers, adequacy of the stack, and the coal problem.

If there should be a question as to whether or not the combustion space is ample for bituminous coal, where bituminous is the first choice, it is assured that the space will be sufficient for anthracite, since bituminous coal is high in volatile matter and requires more combustion space than does hard coal; consequently, retort clearance heights are not, as a rule, critical with anthracite. In laboratory tests it has been demonstrated that an anthracite retort will work successfully very close to the crown sheet. The point for a heating engineer making a survey is that both coals may well be kept in mind to meet conditions as they arise.

Some boilers, particularly those having a full wet base, were designed for oil and cannot be converted to coal. Where it is found that the conversion is feasible, though, other survey steps embrace a list of all needed materials and equipment on which to base the estimated cost, application to WPB for authorization, full engineering data for the use of the manufacturer, and terms of the proposal and contract.

The survey data are usually recorded on forms provided by the installing contractor or stoker manufacturer. Important among essential information to be noted is the actual capacity of the boiler and a fairly accurate estimate of the heat or steam load it must carry.

Other details relating to the proposed conversion include all available data on the boiler, such as dimensions, grate area, and rating. Do not place too much dependence on the name plate; cast iron sectional boiler, for instance, may have had a few extra sections added, and size given on the name plate would be misleading. Thus the actual boiler measurements are usually necessary. In steel boilers of the fire tube type the rating may be based on horse power or heating surface. In industrial installations a required figure would be the maximum demand for steam in pounds per hour.

It should be noted whether the boiler can be raised, if necessary, to increase furnace volume, or if a pit would be required. The report on measurements would include the

ESTIMATE OF INSTALLATION

		COST
1.	Size Stoker Required.	
2.	Controls Required.	
3.	Boiler Front, Doors, Liners. Sq. Ft. Required Size Doors	
4.	Freight and Cartage.	
5.	Pit Requirements, if Required Width. Depth. Length.	
6.	Water Proofing of Pit. If Required.	
7.	Sump Pump, if Required.	
8.	Rearranging Coal Bin, Removing Partitions, Posts, Removal of or Rearranging Drainage Pipes, Acetylene Torch Cutting.	
9.	Estimate Removing Tubes on Down Draft Boilers.	
10.	Removing or Rearranging Baffles, or Smoke Archs in Boiler.	
11.	Stoker Permit.	
12.	Labor Installing L.W.C.O. or Combination Feeder.	
13.	Electrical Wiring Estimates, Including Labor, Materials and Inspection Fee	
14.	Brick Mason Labor.	
15.	Fire Brick: 4½" Wall Req. 6½ Brick per Sq. Ft.; 9" " " 13 " " " "; 13½" " " 20 " " " "; 8000 Fire Brick to Minimum Car Load	
16.	Fire Brick Binder Material. (Sairset, Hiloset, etc. From 350 to 400 lbs. are Required to lay up 1000 Fire Brick.)	
17.	Common Brick.	
18.	Plastic Refractories.	
19.	Cement.	
20.	Mason Sand.	
21.	Fire Clay. (Do not use to lay fire brick.)	
22.	Labor Assembling, Placing Stoker, Fan Unit, Boiler Front.	
23.	Clinker Removal Tray.	
24.	Extras.	
	TOTAL COST	

Fig. 13. Part of a well-designed estimate sheet, prepared by Holcomb & Hoke Mfg. Co. Such sheets are important in making an accurate survey and properly reporting the preliminary data for a conversion order.

Fig. 14. Bunker feed underfeed model Iron Fireman stoker in a New Hampshire newspaper plant releasing approximately 35,000 gal of No. 5 oil a year.

clearance height in the combustion chamber and the clearance available at the grate region for the front, rear and sides of the retort. Sometimes the combustion space is so large that the stoker may be raised a foot or more on a concrete platform, thus permitting some extra ash-collecting space on one side or on both sides of the retort.

The survey not only provides a chance to get all these items of information, but also it is a good time for planning the complete installation. It is a time to keep in mind that the whole conversion should be made as convenient as possible for the operators of the plant, as advised by W. L. Grove, Jr., sales manager, The Frederick Iron and Steel Co., so that the fire, coal, ash and everything else may be handled with the utmost ease, thus assuring a satisfied owner.

In connection with the preliminary engineering, Iron Fireman engineers stress three major considerations: (1) design of the furnace; (2) analysis of draft conditions; and (3) method of storing and handling coal.

The design of the furnace embraces the checking into of such matters as headroom, flame travel, ratio of black surfaces to refractory surfaces, furnace volume, heat release and configuration of the furnace. Volumes have been written on these specific subjects, and standards have been set up. Considering the number of variables, however, the rules and standards can be applied and properly used only by engineers having thorough experience in furnace design and knowledge of past performances under diverse operating conditions. With this, too, the engineers must have the courage of their convictions and apply their knowledge and experience without compromise, if best results are to be obtained.

The analysis of draft conditions has been mentioned as a major consideration. Many oil-burning installations operate at high ratings with little, if any, excess of draft provision. In such cases, a thorough analysis of the entire draft system is necessary to insure that there will not be a deficiency of draft when the coal-burning equipment is installed; or, if the deficiency of draft for coal-burning is in evidence, some provision for obtaining more draft must be provided.

Stokers, by virtue of their integral forced draft equipment, have a wide advantage over hand-firing in the matter of draft where conversion is being made from oil, and there are many plants which can be successfully converted from oil to stoker fired coal, where with hand-firing the boiler loads could not be satisfactorily carried.

(Also see "Combustion" and "Chimneys," parts of this section.)

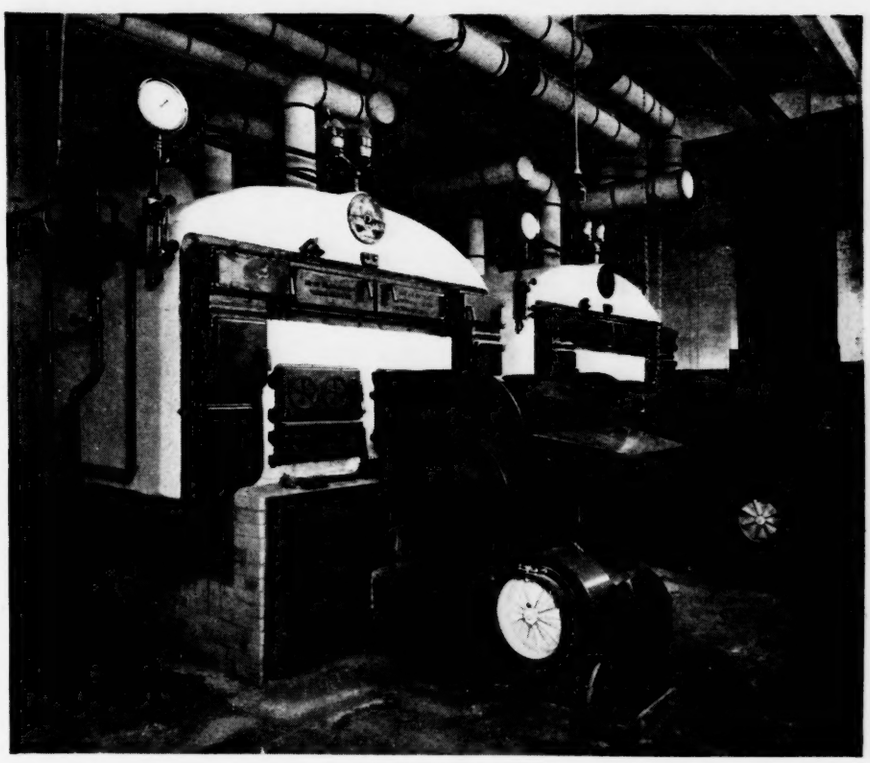


Fig. 15. An oil to coal conversion in a school in Peru, N. Y., where Skelly stokers have been applied to two large H. B. Smith boilers.

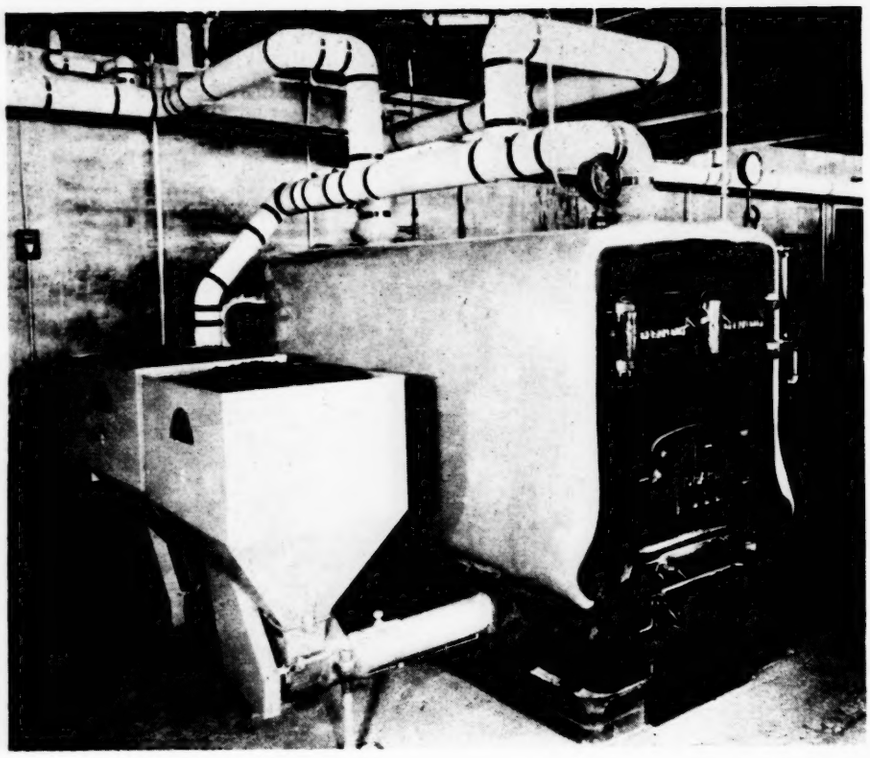


Fig. 16. Twin installation of a Gilkoal stoker made by the Catskill Metal Works, Inc. This company recommends installation through the side of the boiler wherever possible. One advantage of this is that it permits easy ash removal from the front.

CHIMNEYS

In many buildings erected in recent years intended for use with oil firing, architects and engineers were inclined frequently to specify chimneys 15 to 20% smaller than would have been built for coal. Thus it happens that some difficulties are now found in a number of such cases when the plants are being converted to stokers. A deficient stack may be a handicap to the best stoker performance.

An under-sized stack condition is helped by the fact that the stoker fire gives off some heat to warm the chimney somewhat by the hold-fire control where the installation makes use of intermittent heating. Under this arrangement there should be some ready draft at all times. With an oil burner the chimney cools to a greater degree during the off periods. Then the oil flame goes on full blast at the start of firing. With coal the stoker fire does not flame at full heat immediately. The chimney is given a chance to warm up and get adjusted to the combustion gas load. It would appear, then, that the stack which could start almost cold and take the full fire of the oil burner, should not be so seriously deficient for a fairly good stoker fire. The difficulty may be in seeking over-rating in capacity.

A stack deficiency may sometimes be overcome by using a better grade of coal. The actual stack conditions are carefully tested in all properly installed stoker conversions. The use of draft gauges and CO_2 indicators is regarded as essential and regular practice. The stoker manufacturer usually outlines desired conditions in his recommendations on operating. The usual "over-fire" draft runs from a minimum of 0.03 in. of water up to 0.10 in., the average being about 0.05 in.

When it is only the smoke breeching that is undersized, the correction is easy if the needed materials are at all available. A thorough inspection of the stack and the breeching is always an important part of the preliminary survey. The chimney should be examined for all common defects, such as a poorly designed cap or a needless choke at the top. In domestic jobs all fireplaces, cleanouts, check drafts, gas heater vents, water heater connections, air leaks in brick work, loose joints around thimbles or breeching connections, should be thoroughly sealed.

Tight cleanout openings should be provided in the breeching or chimney bottom so as to permit the cleaning out of collected soot or fly ash and the smoke pipe should slant upwards as much as possible towards the stack. If it is possible to increase the height of the stack, that is one method of improving its draft. There is no government restriction on the use of brick. Where the chimney does not run straight up, it will surely require a good cleaning of offsets or ledges.

In industrial jobs it is common practice to use induced draft fans in the boiler breeching to assure proper draft. There are, in fact, numerous stoker-fired plants in areas where tall chimneys are prohibited because of aircraft, which employ induced draft fans and have very short stacks.

Class A stokers as a rule are forced-draft appliances. The chimney draft should be sufficient to carry off the products of combustion. The draft should be so good that a smoke pipe damper is required. The inclusion of a damper is considered a "must" on practically all Class A stoker installations, and almost invariably an additional automatic barometric draft stabilizer is included. The old style check draft is eliminated or tightly closed. If the breeching includes an oil burner safety stack switch, it should be removed. The flue gases generated by some types of coal will cause deterioration of its metal parts even though it may not seriously obstruct the draft.

Where a stack deficiency is met, it means that the full capacity of the stoker may not be guaranteed and there is doubt as to obtaining any excess capacity from the boiler. If the stack cannot carry off the normal flue gases, the stoker must be regulated to operate at a reduced rate. If the smoke breeching has some abrupt turns in it, it should be oversized at least two inches to reduce friction or designed so as to eliminate sharp turns. Another point often overlooked is that the boiler room

should have an ample supply of incoming air from other parts of the building, or through small air intakes specially provided. Many boiler rooms have tightly fitted fireproof doors and normal air infiltration is limited.

The boiler and stoker setting should be tightly sealed at all joints and crevices, not only to assist the stack draft, but also to control fly ash. Whatever air gets into the combustion chamber should be that provided for the intended coal burning purpose, and it should be controlled, allowing some excess air. When the stack takes care of the air necessary for combustion, it is doing its duty; any extra air slipping in through a number of unobserved openings is excess baggage. A simple test for discovering such defects is to close the damper all the way and watch for the smoke as it puffs out at any telltale leak spots. The damper should then be locked or blocked in some way to prevent its being inadvertently closed tight any other time.

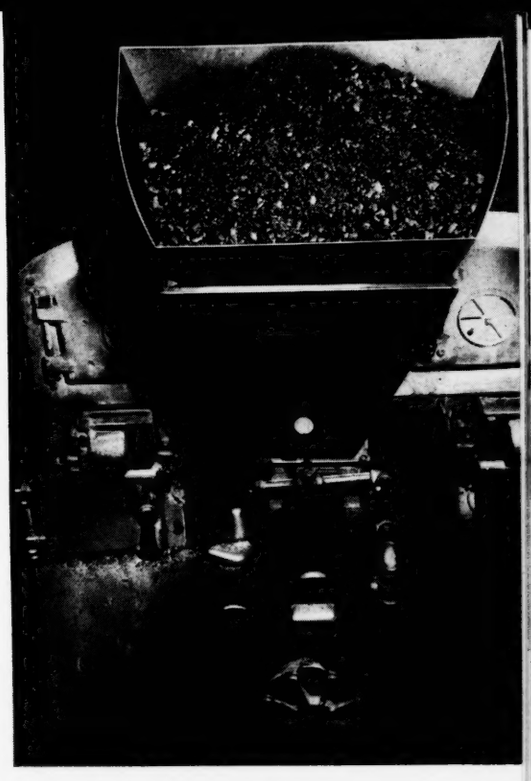


Fig. 17. An Auburn hudraulic ram type stoker installed in the Willard Hotel, Washington, D. C., where coal is replacing bunker C oil. Installation was made by the Taylor Engineering Company of that city.

CONTROLS

In making conversions from oil burners to stokers the controls already installed will be studied to see which are satisfactory for re-use. So long as a homogeneous series is used, only slight changes may be required, such as the installing of a timer relay instead of the safety stack switch relay. Stoker installations include a holdfire timer (except where operation is continuous in some power applications), needed so that the fire in the retort will not burn out after a short time if left unattended. Thus the fan and coal feed are turned on automatically for a few minutes each half-hour or hour as the case may be. The intermittent holdfire operation may run anywhere from about one minute to seven, as adjusted, depending on the coal being used, type of stoker and so on.

Large stokers as a rule do not require as long a holdfire period as smaller ones. Anthracite may call for only a half-minute "on" period per hour, but it is deemed safer to arrange a timing of two minutes in an hour or one minute every half-hour. The purpose is to keep the fire sufficiently alive so that the full fuel bed will respond promptly when the room thermostat acts. Longer timing periods are required for bituminous coal, generally about four minutes in each half-hour. Where the building does not employ a thermostat, the high and low limit switch is generally used to keep the stoker in operation. Stokers usually include an overload switch to cut out the motor in any jamming; it is generally part of the motor but should be installed separately on the line if not already provided.

Such standard controls as the low water cutout are to be recommended for all steam jobs. The ordinary simple control set-up embraces the master switch, single or three phase, a three phase starter if required, and the main relay unit, which includes the timing mechanism and the low voltage wiring for the thermostat. The high limit cutout and low water safeguard will run in series on the power line to the motor.

The fully equipped stoker installation may include—or the boiler room already may be provided with —some simple draft gauges to indicate conditions in the stack or over the fire. On the larger jobs an air pressure guage may be used to report on under-the-fire blower fan pressure, giving warning by increased pressure of clinker formations, coking, or excessive fines, while a falling pressure may indicate thin spots in the fire bed or impending blow holes. A flue gas temperature indicator will tell when

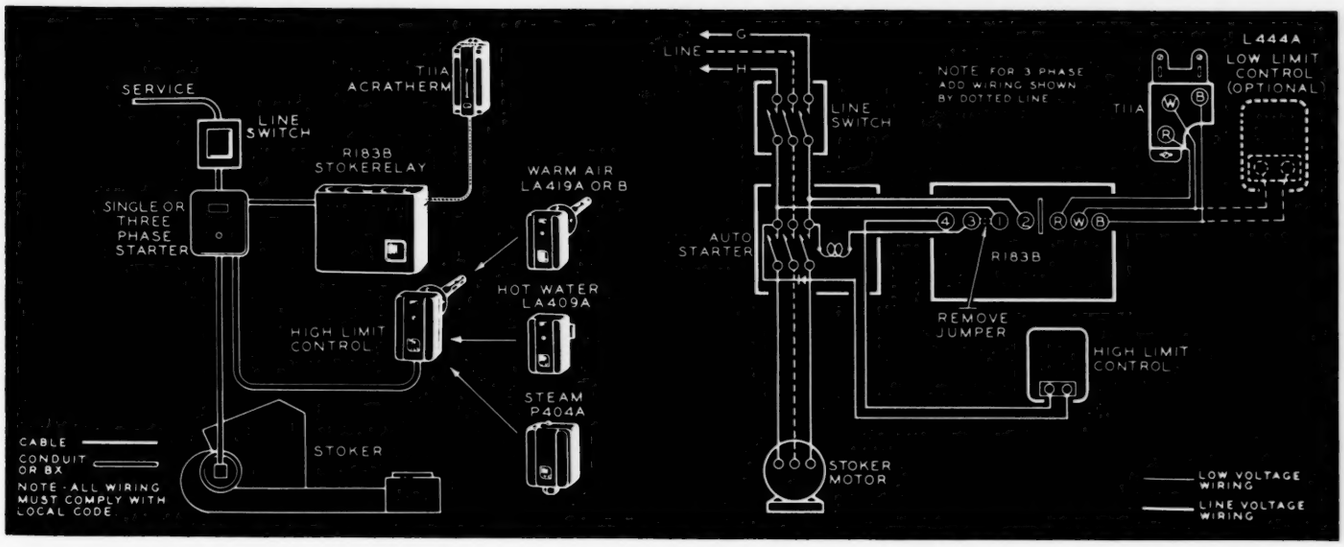


Fig. 18. Layout of Minneapolis-Honeywell automatic controls for a stoker conversion. This illustrates the customarily used equipment, including stoker relay, excepting that a low water safety control can be cut into the line which carries the high limit cut out.

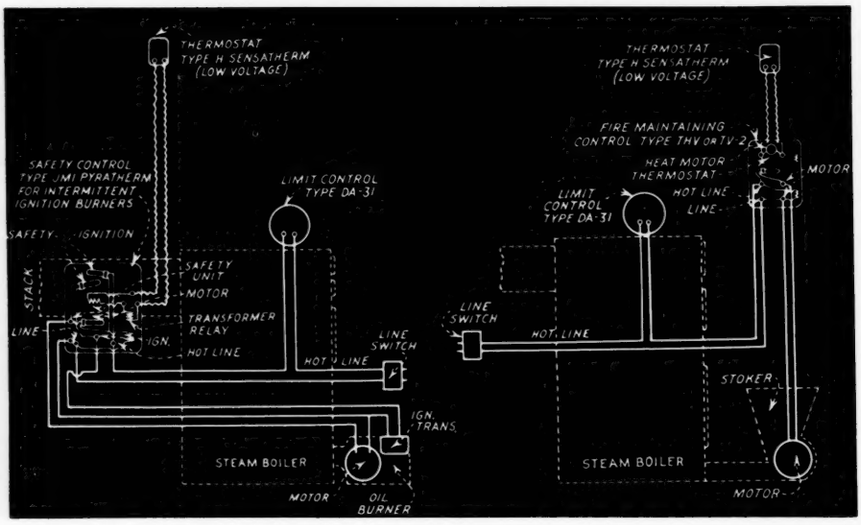


Fig. 19. Two drawings illustrating the changes necessary in a Mercoid controlled oil-fired system to convert it to a stoker-fired system, the drawing at the left being the oil installation. The same controls, with the exception of a JMI stack safety control, would be used when changing from oil to a stoker. Instead of the JMI safety control, however, type TV-2 or THV Mercoid Stok-A-Timer would be used. The foregoing statements also apply to hot water or warm air systems.

flues need cleaning or boiler needs other attention, such as adjusting the barometric draft stabilizer. An electric piston with automatic control and reversible motor may be connected to a jack shaft along the front or rear of a battery of boilers to regulate fuel feed or damper settings, or for various lever controls on individual boilers.

SIZING THE STOKER

Selecting the size of the stoker is easy enough in the majority of instances, but here and there will be a borderline case where the manufacturer has two sizes available. In theory, the smaller size stoker should be selected so long as it could be made to serve, for it is a matter of patriotic obligation now to help the nation in its need for conserving all critical metals. On the other hand, it is a sound engineering rule to provide a margin of safety for all mechanical equipment.

Two Don'ts to remember when selecting a stoker, according to Whiting Stoker Corporation, are: (1) Don't undersize a stoker, because it will usually prove to be a source of dissatisfaction to the owner; (2) don't make the mistake of intimating or promising that a stoker will cure the defects in a heating system. It is true that the stoker should increase the load-carrying capacity of the boiler or furnace, but heating system defects should be corrected independently.

A frequently quoted rule on sizing heating plant stokers is that the stoker should be sized for the load or the boiler rating, whichever is larger. It is not easy to be precise about the rating of a boiler, however, and in all probability rule No. 1 should be that the surveying of stoker installations requires well qualified heating men and engineers. Expert judgment is part of the service the stoker industry is prepared to provide for the public. If the load is larger than the boiler, there is no choice because the stoker must be able to satisfy the heating requirements. It is then a question of whether the boiler has sufficient combustion room, clinker space, smoke stack area, heat absorption surface, and so on. Some engineers use a general rule that the minimum size of the stoker in a given heating plant boiler should have a rating at least 75% of that of the boiler, always presupposing that the stoker rating is sufficient to carry the heating load.

For larger boilers it is suggested that the heating load should not exceed the boiler rating by more than 20%. However, the installations now occupying the stoker industry are conversions from oil or handfiring and the replacing of old stoker equipment; the boilers and the plants have been in operation and have been tried out, and the actual boiler capacity demonstrated.

Where the boilers are of the steel firetube type, with a high ratio of heating surface to grate area, they may be pushed to relatively high ratings without much loss of efficiency. Ratings of steel boilers are ordinarily based on their heating surface and may be calculated if not readily available in catalogs. The ratio of square feet of steam heating surface (radiation) per square foot of boiler heating surface for firetube

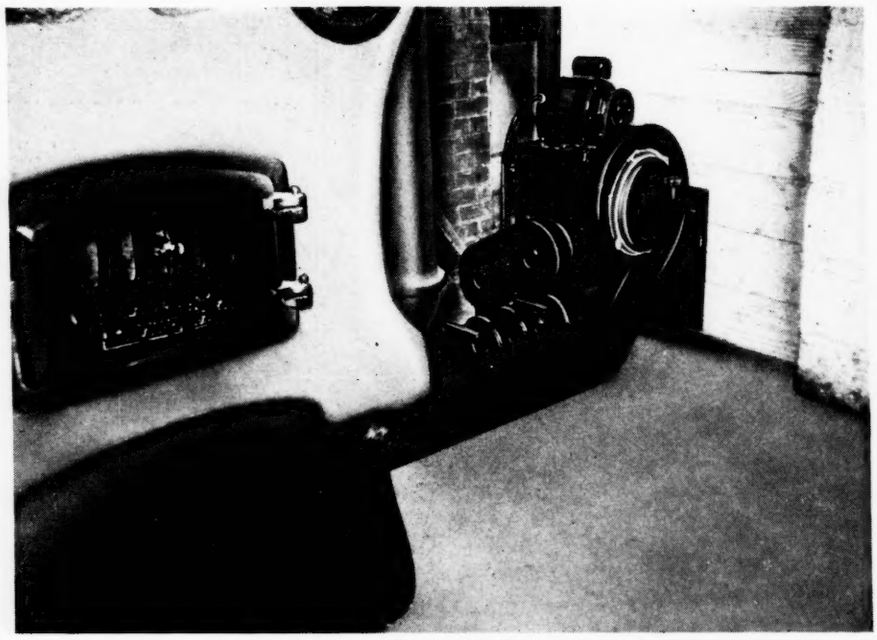


Fig. 20. According to Schwitzer-Cummins Co. a binfeed Stokol installation such as this has proved particularly valuable where the owner must not only stop using oil but is faced with a manpower shortage as well.

boilers runs from about 12 sq ft of radiation per sq ft of surface in the smaller boilers, to 14 for the sizes having 1,000 sq ft of heating surface or more.

On combustion space some engineers use the figures 1 cu ft of combustion volume per boiler horsepower, 1 cu ft of volume per 3 lb of coal fed per hr., and 1 cu ft of volume per 1.5 to 2.5 lb of oil per hour. This corresponds to a liberation of about 38,000 Btu per cubic foot per hour, although at times even higher rates of oil consumption have proved satisfactory.

This suggests one measuring stick for rating oil-fired boilers if the rating is not otherwise available. Ratings based on fire-chamber volume may be checked against ratings indicated by the total boiler heating surface. At the same time, the actual nozzles or cups installed in the oil burners should be checked for capacity. From these data, knowing the coal to be burned, the needed tonnage may be determined in quantity per hour and per heating season.

The three important items on which to base the stoker size are boiler capacity, total radiation load, and previous fuel consumption. The radiation load will include an addition of 20% to 33% to cover piping losses and pickup, depending on the circumstances, and will also include heat required for service hot water supply, if furnished by the stoker.

A representative stoker sizing calculation may assume a direct steam radiation load, or its equivalent, of 3,200 sq ft. If the safety and piping loss margin is assumed at 30%, the total load is 4,160 sq ft, neglecting service hot water, so that the total Btu heat loss requirement is 4,160 $\times$ 240 = 998,400 Btu per hour. If the coal has a heat content of 13,000 Btu per lb, the over-all plant efficiency is 65%, and the stoker will operate 70% of the time, the output is 13,000 $\times$ .65 $\times$ .70 = 5,915 Btu per lb of coal per hour available.

The fuel required is thus $\frac{998,400}{5,915}$ = 168 lb of coal per hour as the needed stoker capacity. Checking this figure with Rating Chart No. 2, Stoker Manufacturers Association, for stokers having burning rates of from 110 to 600 lb of coal per hour, the indicated required burning rate for the stoker is about 150 lb per hour. S. M. A. in its rating code includes tables to assist in precise figuring of stoker ratings, based on an allowance of 33% for pickup and piping. For the job we are considering we may assume the total per Btu load at 1,000,000. According to S. M. A. tables, this calls for a stoker capacity of 110 to 115 lb per hour of coal having 13,000 Btu. The net radiation load in the table checks closely, at 3,125 sq ft with an original assumed figure of 3200.

The Stoker Manufacturers Association's Uniform Stoker Rating Code is widely used, as is the S. M. A. standard code on recommended minimum setting heights for stoker retorts in steel and cast iron boilers, the headroom running from 18 to 58 inches and the coal burning rate from the smallest size up to 1200 lb per hour. The Association may be addressed at 307 N. Michigan Ave., Chicago, Ill.

Stoker loads in tables are usually expressed in square feet of steam with a heat emission rate of 240 Btu per sq ft. Many of the modern heating systems are forced circulation hot water, and the old figure of 150 Btu per sq ft of radiation for gravity hot water is too low for a forced hot water system, which runs as high as 200 Btu per sq ft per hr.

The domestic hot water load must be estimated where it is part of the heating system. For putting the hot water requirements on an equivalent steam radiation basis, a common rule is to multiply the capacity of the storage tank in gallons by .5 for a coil submerged in the boiler water, and by 1.5 where the coil is an exterior indirect one or is submerged within the storage tank. Where the hot water supply is of the tankless, instantaneous variety it will be necessary to calculate the actual consumption at peak hours to supply the number of families involved plus laundry or other uses.

When sizing stokers for industrial plants the only safe method to meet the highly fluctuating demand on the steam boilers, is actually to weigh the coal or oil consumed during the period of maximum demand. This implies an inspection of the boiler room and the firing methods, particularly to be certain that the firemen do not begin an hour or two ahead of time to overload a handfired boiler in preparation for the peak call. A stoker cannot overload a fire in advance of a peak demand in this manner. Once a dependable estimate has been made of peak fuel consumption, the heating value of the coal to be used in the stokers should be determined and compared with that of the fuel already at the plant.

Fig. 21. Two Brownell stokers installed in the heating plant of the B. Altman & Company department store in New York to replace an oil installation.

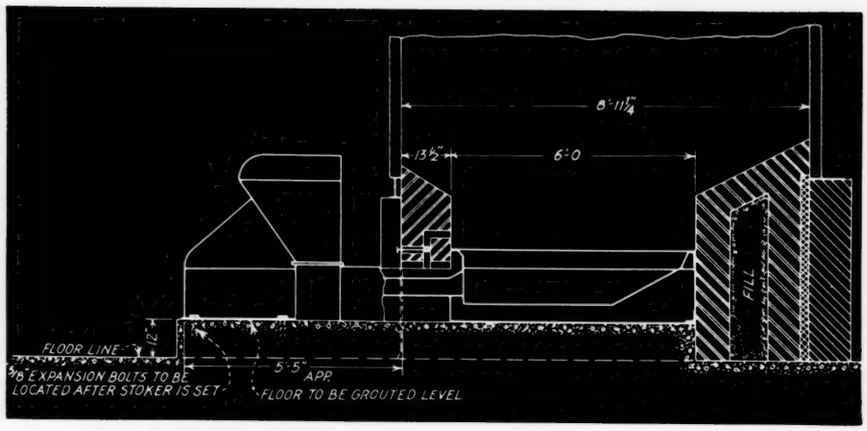


Fig. 22. A Combustion Engineering installation showing how refractory has been built up in the rear of the boiler.

INSTALLING THE STOKER

The engineering of the conversion may include the preparation of drawings and specifications by a consulting engineer. In preparation for this the building must be studied for such particulars as coal storage and handling, ash removal requirements, and full details of actual stoker installation and alteration of boiler.

Where the work must be offered for public bidding, the legal department will undoubtedly attend to the preliminary specifications covering wage rates, schedule of payments, inspection and tests, insurance, and similar stipulations and precautions common to construction contracts. The work embraced by the project may be summed up in the following paragraph from a typical specification; "Work to be Done—The work to be done consists of furnishing all plant, labor, and materials, and perform all work required, for conversion from oil to stoker firing for the buildings listed herewith, complete in accordance with these specifications and drawings forming a part hereof, together with such additional work as needed or ordered by the owners or their authorized representatives."

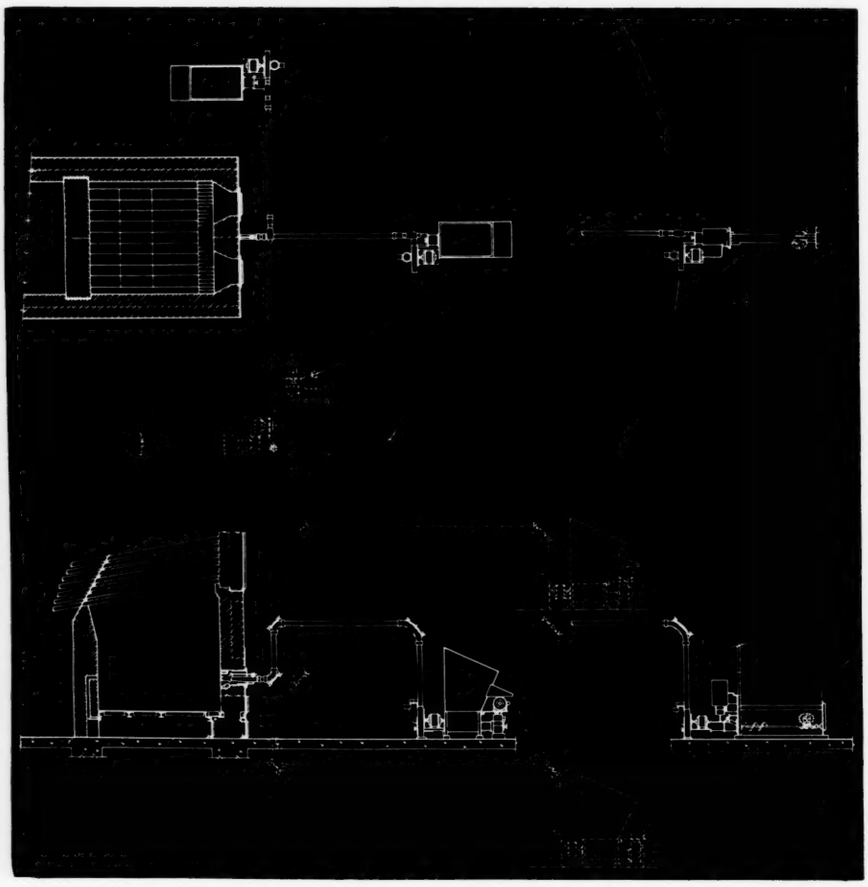


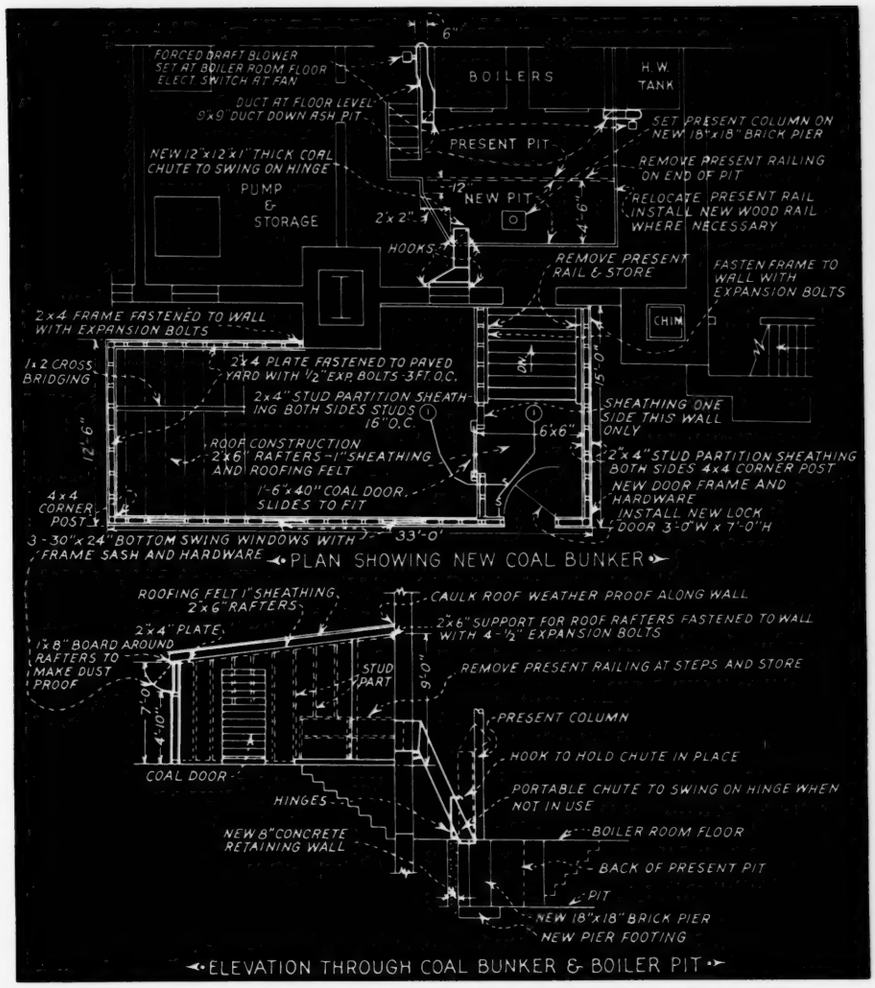
Fig. 23. The versatility of a pneumatic spreader type stoker is here revealed. The unit may be located in front of boiler or to either side, or on a level above or below the boiler room floor. This type stoker is being used in some cases where the furnaces are not wide enough for conventional stokers.

A few comparatively small drawings will be required as a rule. In a typical instance the drawings will show a plan view of the boiler room, location of the boilers, pits, stairways, windows, doorways, and such, with outlines of the intended new coal bin or bunker and any elevations necessary to bring out construction details. The other drawings will go into details of the work at the boilers, with whatever longitudinal or cross sections that may be required. A typical drawing of this kind is shown in Fig. 24 for the conversion of a New Jersey building, in this case embracing hand firing for the present, as prepared by Krey & Hunt, consulting engineers, New York.

The boiler room plan, Fig. 24, reveals the method of constructing a coal bunker on the outside of the building at grade, making use of a basement window for a chute. A flight of steps leading to the basement is now inclosed as a protection to the fireman whenever engaged in shoveling at the coal bin. In front of the boilers the pit has been extended so as to make space for a pile of standby coal. Note the improvization on the part of the engineers where the new chute would otherwise block a passageway; its bottom is hinged so that it may be turned out of the way when not in use. The boilers will have forced draft blowers.

Where it is necessary to use a portion of the basement for coal storage, Schwitzer-Cummins engineers urge that the installer be careful to construct the walls of the bin strongly because the fuel exerts considerable pressure against the retaining walls. Further, line the ceiling and side walls of the bin, if of wood, to keep the coal dust from penetrating throughout the building. It is good practice to provide drainage for the coal bin floor to avoid dampness

Fig. 24. Working drawing for the rearrangement of a boiler room where an oil to coal conversion is to take place. This drawing is illustrative of the type furnished by consulting engineers for this type of work and in this case is taken from a drawing by Krey and Hunt, New York consulting engineers.


FORCED DRAFT BLOWER SET AT BOILER ROOM FLOOR ELECT. SWITCH AT FAN
DUCT AT FLOOR LEVEL 9"x9" DUCT DOWN ASH PIT
NEW 12"x12"x1" THICK COAL CHUTE TO SWING ON HINGE
PUMP & STORAGE
BOILERS
H.W. TANK
PRESENT PIT
NEW PIT
SET PRESENT COLUMN ON NEW 18"x18" BRICK PIER
REMOVE PRESENT RAILING ON END OF PIT
RELOCATE PRESENT RAIL INSTALL NEW WOOD RAIL WHERE NECESSARY
HOOKS
REMOVE PRESENT RAIL & STORE
FASTEN FRAME TO WALL WITH EXPANSION BOLTS
2"x4" FRAME FASTENED TO WALL WITH EXPANSION BOLTS
1"x2" CROSS BRIDGING
2"x4" PLATE FASTENED TO PAVED YARD WITH 1/2" EXP. BOLTS 3 FT. O.C.
2"x4" STUD PARTITION SHEATHING BOTH SIDES STUDS 16" O.C.
SHEATHING ONE SIDE THIS WALL ONLY
ROOF CONSTRUCTION 2"x6" RAFTERS 1" SHEATHING AND ROOFING FELT
1'-6"x4'0" COAL DOOR SLIDES TO FIT
2"x4" STUD PARTITION SHEATHING BOTH SIDES 4x4 CORNER POST
NEW DOOR FRAME AND HARDWARE INSTALL NEW LOCK DOOR 3'-0" W x 7'-0" H
4x4 CORNER POST
3-30"x24" BOTTOM SWING WINDOWS WITH FRAME SASH AND HARDWARE
33'-0"
PLAN SHOWING NEW COAL BUNKER
ROOFING FELT 1" SHEATHING 2"x6" RAFTERS
2"x4" PLATE
1"x8" BOARD AROUND RAFTERS TO MAKE DUST PROOF
CAULK ROOF WEATHER PROOF ALONG WALL
2"x6" SUPPORT FOR ROOF RAFTERS FASTENED TO WALL WITH 4-1/2" EXPANSION BOLTS
REMOVE PRESENT RAILING AT STEPS AND STORE
STUD PART
PRESENT COLUMN
HOOK TO HOLD CHUTE IN PLACE
COAL DOOR
PORTABLE CHUTE TO SWING ON HINGE WHEN NOT IN USE
HINGES
BOILER ROOM FLOOR
NEW 8" CONCRETE RETAINING WALL
BACK OF PRESENT PIT
PIT
NEW 18"x18" BRICK PIER
NEW PIER FOOTING
ELEVATION THROUGH COAL BUNKER & BOILER PIT

from the surface moisture usually present with anthracite when delivered.

Sometimes where the basement ceiling is below ground level, this company points out that it has provided a tile duct connected with a manhole properly covered to get the coal to the storage space.

The constructing of an outside coal bunker will be the solution in many instances where storage space is lacking in or near the boiler room. One consulting engineer has recommended that the structure may be inexpensively designed so as to harmonize with the architecture of the building and may make use of a vitrified tile pipe chute run through the building wall if no basement window is handy. A 12-inch square chute may be secured to the wall on the inside of the building and have a gate at its bottom, to be opened to discharge coal into a wheel barrow.

A further suggestion, which may seem costly, but is worth considering by those who are making a permanent change, is that coal bunkers may be constructed of masonry under a driveway on which coal trucks may back up close to the boiler room location. The coal would be dumped through manholes. An access door would open from the basement into the vault and wheel barrows or mechanical conveyors would carry the coal to the boiler room. If there is ample space on the outside of the building and the basement is deep enough, the underground storage vault could be located, of course, in the most suitable spot. It would become in effect an extension or small added wing of the basement. The method has been used successfully in some cases where a bin-feed coal tube has been installed, the feed screw carrying the coal from vault to hopper or directly to the retort.

Oil flows through pipes. In general, laymen and even many engineers have not thought of coal as a fuel which can be conveyed in this manner, and yet there are large numbers of stoker installations where coal is being conveyed through pipes from the main coal bunker to the combustion chamber.

There are two general methods of conveying coal through pipes. One is by advancing coal progressively by means of an internal rotating worm. The other consists of conveying the coal pneumatically on a stream of

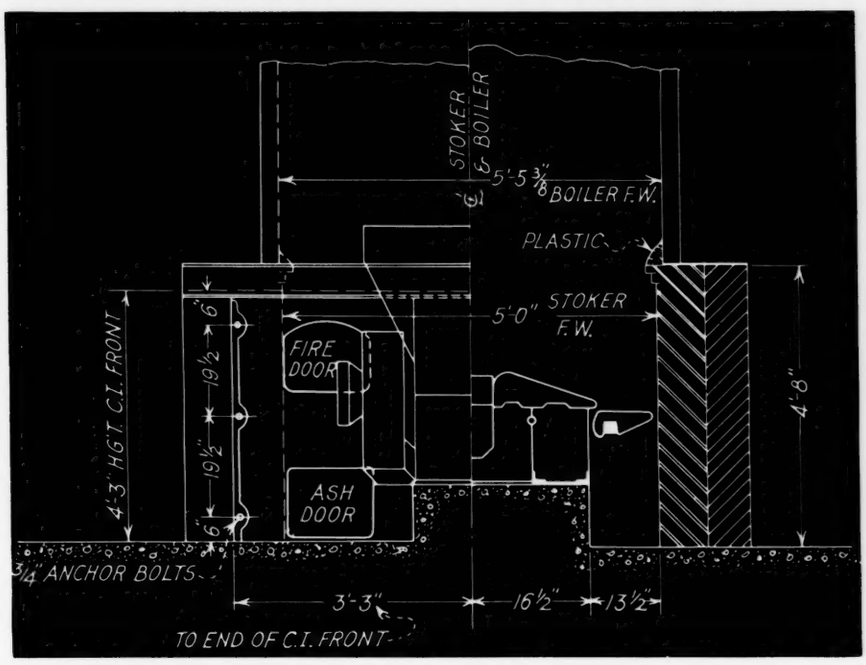


Fig. 25. Sectional drawing showing application of Skelly stoker to a Fitzgibbons boiler.

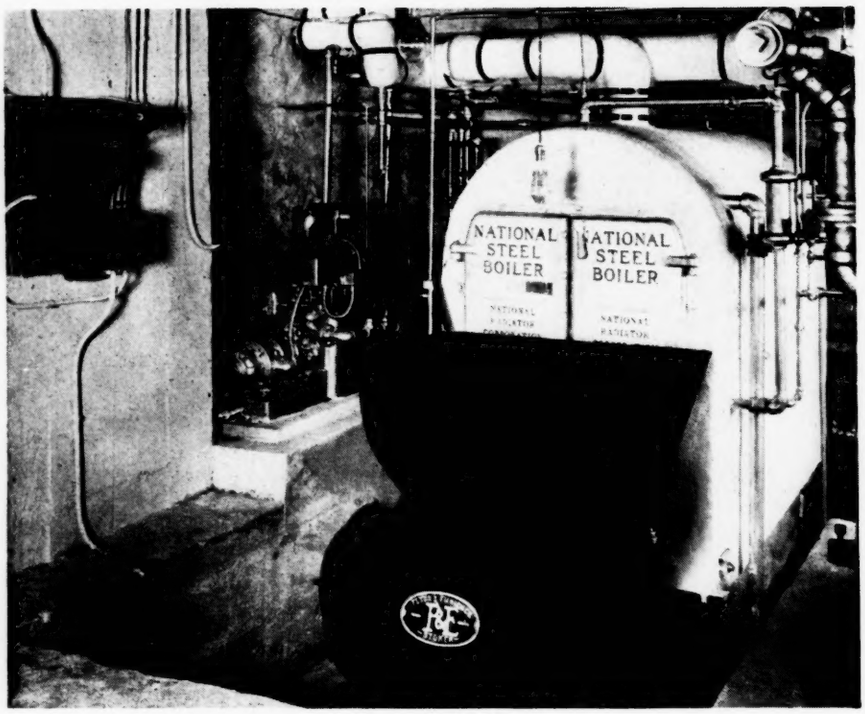


Fig. 26. A Flynn and Emrich anthracite burning ram type stoker as installed in the boiler of a steam heating plant.

air, or a mixture of air and heated gases, under pressure.

The typical cases of such installations which are presented here may be of interest, since they suggest means for the solution of similar conversion problems. Fig. 14 shows a typical installation of an underfeed stoker of the bunker feed type, which automatically feeds coal direct from a bunker, located outside the boiler room, thus eliminating all manual coal handling.

This case is representative of many in which the coal flows through a pipe of considerable length direct from the coal storage space to the furnace, a rotating spiral worm inside the pipe giving motion to the coal.

In the case of pneumatic spreader stoker installations, many arrangements, which lend themselves to oil burner replacement, are possible. The coal supply and stoker can be located on the same level as the boiler room, on the floor level above, or on the floor below. The stoker can be placed at any desired angle with reference to the boiler front, and at a considerable distance away, leaving the boiler front clear for inspection and cleaning of fires. See Figs. 23, 28, and 29.

The mechanical work in installing the stokers in converted jobs is interesting and diversified. All oil burner equipment is carefully removed and the oil refractories taken out. The boiler smoke pipe, and chimney are given a thorough cleaning of all scale collections and soot, the larger boilers being cleaned by those who make a specialty of the work and use mechanical scrapers and vacuum brushes. Then the fire chamber walls and foundations are reconstructed as may be required.

Many oil burners were installed in rear settings, while the stoker is to go in the front. However, the locating of the stoker is one of the big convenience studies in each instance. The majority of the conversion stokers will have hoppers to be hand-filled. Other things being equal, will it help the operator if the stoker is placed to the rear or to one of the sides? Where there is no mechanical conveying of the coal, then hopper and coal dump should be as close to each other as possible. The available space must be examined so as to assure the ready movements of a wheel barrow and even the swing of a shovel.

In this connection, Walter Sormane, sales manager, stoker division, Schwitzer-Cummins Co., reports that his company has made several applications with the coal bin outside and back of the building and with the stoker installed from the rear. This, he adds, saves space and also promotes cleanliness.

The stoker will be set so that fire

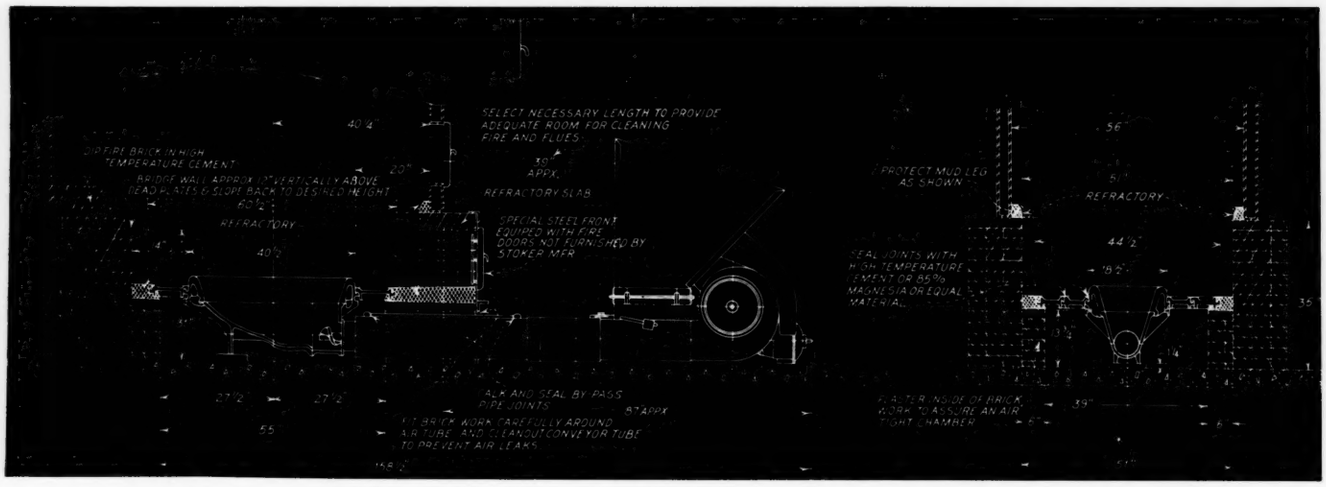

SELECT NECESSARY LENGTH TO PROVIDE ADEQUATE ROOM FOR CLEANING FIRE AND FLUES
REFRACTORY SLAB
SPECIAL STEEL FRONT EQUIPED WITH FIRE DOORS NOT FURNISHED BY STOKER MFR
REFRACTORY
PROTECT MUD LEG AS SHOWN
REFRACTORY
SEAL JOINTS WITH HIGH TEMPERATURE CEMENT OR 85% MAGNESIA OR EQUAL MATERIAL
PLASTER INSIDE OF BRICK WORK TO ASSURE AN AIR TIGHT CHAMBER
SEAL AND SEAL BY PASS PIPE JOINTS
LT BRICK WORK CAREFULLY AROUND AIR TUBE AND CLEANOUT CONVEYOR TUBE TO PREVENT AIR LEAKS

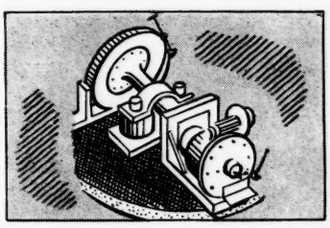
Fig. 27. Typical working drawing for installation of a Winkler stoker as furnished by the U. S. Machine Corporation. In this particular instance the stoker is installed in a Pacific boiler in an upstate New York school building.

THIS *INTER-PLANETARY* DRIVE

HAS REVOLUTIONIZED ALL STANDARDS OF STOKER PERFORMANCE

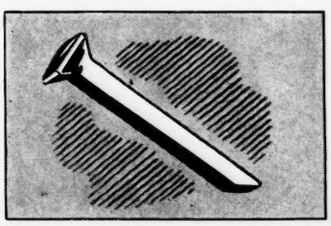
1. WEAR-OUT TEST

A Winkler Transmission was run *continuously* for one full year, *carrying a Prony break load of 600% over normal!* The running time, considering the overload, represented over 30 years of normal service. Upon inspection by engineers, not a single part showed noticeable signs of wear.



2. OBSTRUCTION TEST

A railroad spike was inserted to block the feed screw. An automatic counter recorded the number of times the Safety Release disengaged and then restarted the motor in an attempt to crush the spike. *The Transmission was permitted to disengage and reset itself more than 100,000 times!* Inspection by engineers showed no damage of any nature.



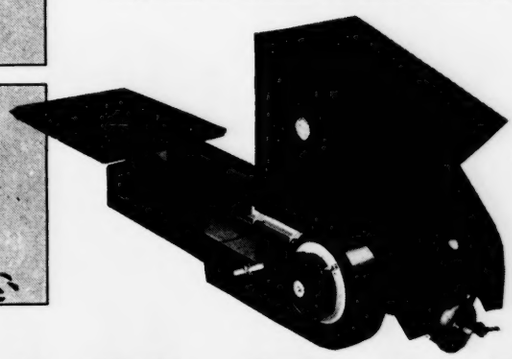
3. LOW GRADE FUEL TEST

A 30%, three-inch mix of stones, bricks and concrete scraps was added to the poorest grades of mine-run coal, mostly slack and dust. Due to the Transmission and the Release, this mixture was crushed and fed to the fire without attention or damage.

Today's fuel oil emergency and man-power shortage place a premium on failure-proof, industrial stokers. Therefore, showing you how the feed screw of a Winkler Stoker will chew a 2 x 4 into matchwood—*or grind a rock to fragments*—is not just a showman's trick! It is a power demonstration of importance to men responsible for the conversion of oil to coal.

A stoker is no better than its driving mechanism—*and on this point the Winkler Stoker invites the most critical comparison!* The well-known mechanical advantages of *internal planetary gearing* are ingeniously employed to provide a transmission of extraordinary power. Power enough to crush 90% of the obstructions in the coal which ordinarily cause a service disruption!

If the obstruction should prove uncrushable, the Winkler Locked Screw Safety Release goes into action—*disengaging and resetting* the Transmission until the object is removed. No shear pins to replace—no overload switches to reset—*the Winkler Stoker has the only fully automatic Transmission, guaranteed for three years.*



FREE BOOKLET

The Winkler Engineering Department has published an interesting brochure on the mechanics of inter-planetary gearing as applied to Winkler Stokers. Your request for a copy will be promptly honored.

PHONE OR WRITE!
Call your nearest Winkler dealer for full information... or write direct to the factory.

WINKLER

fully automatic STOKERS

U. S. MACHINE CORPORATION • LEBANON, INDIANA

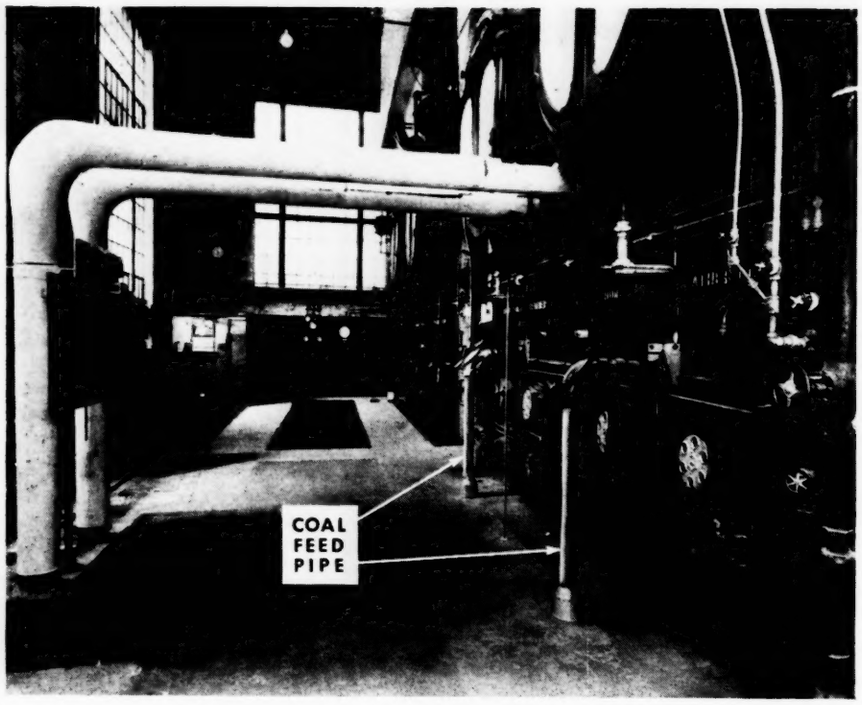


Fig. 28. This boiler room with Iron Fireman spreader type stokers is 32 ft above the bottom of the coal bunker. Also see Fig. 29 below.

and cleanout doors will not strike the hopper, and with the fire door and cleanout openings made as accessible as possible. Sometimes to get this accessibility, a longer coal feed tube may be necessary. Sometimes accessibility may require the setting up of a narrow platform to bridge over the feed tube and air duct, permitting the operator to stand in the center if need be, or to place clinker containers handy to the central fire door. On converted boilers it may be necessary at times to take larger clinkers out the main fire door.

Where the stoker has a round or square retort, it may be possible to arrange a side setting; but generally the retort is long and narrow and must fit regularly in the rectangular grate area. Where the retort is round it may be possible to set the stoker a little to one side as in the plan view of Fig. 38, so as to make it somewhat more convenient to open the boiler door and attend to the fire. The boiler base may have a full front plate that can be removed and permit setting the stoker still more off center.

The elevation, Fig. 38, shows some other interesting details. One of the big inconveniences in many conversions is a high fire door and lack of space for good clinker cleanouts at the hearth level. The drawing evidently shows a small clinker door. Most manufacturers are ready to supply clinker doors, if needed, with hooks to serve as anchors in the new brick work. The drawing suggests an angle of not more than 45° for the handle of the rake from the edge of the retort to the bottom of fire door. The retort could be set accordingly if the grate area is ample. If it were not possible to get a clinker door in the hearth area as shown in the drawing, it would probably be necessary to arrange a pit for the stoker so as to place it at a lower level.

Pits are avoided wherever possible, but a pit might be necessary to per-

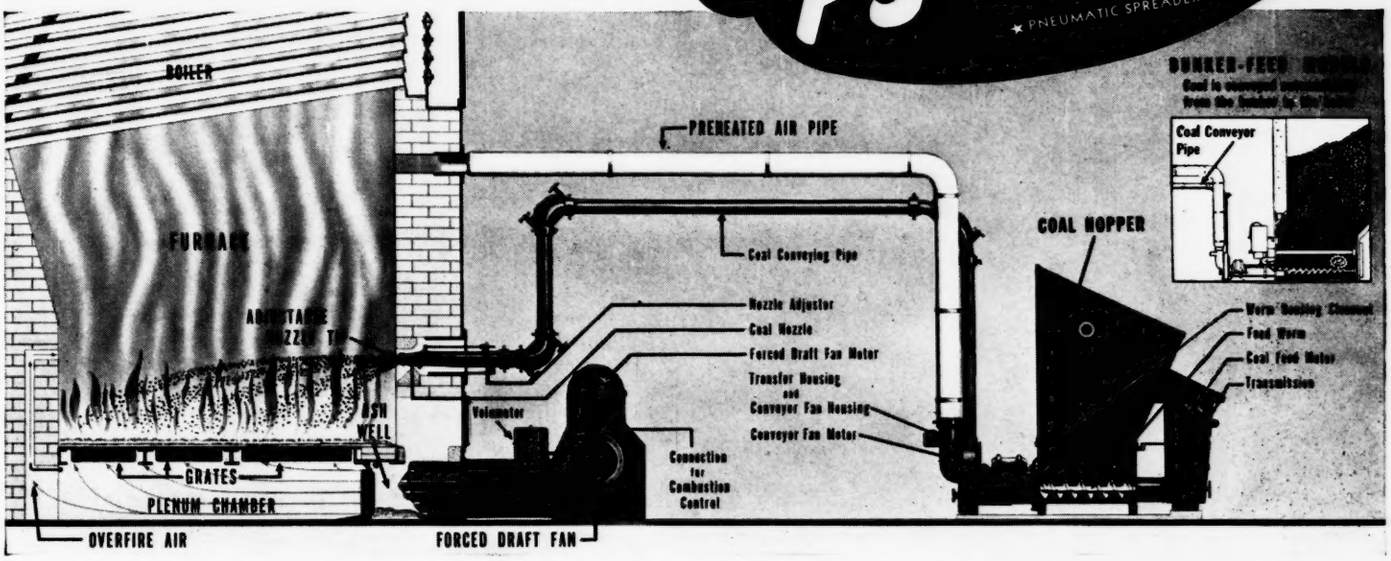
Fig. 29. Coal conveying pipes and stoker feeding mechanism in the sub-basement, for the installation shown in Fig. 28.

Fastest Growing Type of Firing in U.S. Industry

AMERICA'S power and heating plant engineers immediately recognized, when it was announced nearly a decade ago, the important engineering advance embodied in the Pneumatic Spreader principle. Year after year, Iron Fireman Pneumatic Spreader stoker firing has been the fastest growing type of firing in U. S. industry. Today, Iron Fireman Pneumatic Spreaders are making an important contribution to the war effort by stepping up steam output of typical boiler plants 10% to 35%, and at the same time cutting fuel costs. Automatic firing and coal handling gives boiler room employees more time for productive work.

IRON FIREMAN P.S.* STOKER

* PNEUMATIC SPREADER



How the P. S. Stoker Achieves Its Remarkable Results

AS shown in the illustration above, the Iron Fireman Pneumatic Spreader conveys steam size coal from the hopper or main coal bunker to a transfer housing, where the coal is picked up by a stream of air and conveyed to the furnace and grates. The fines burn in suspension, utilizing the conveying air for combustion. The larger pieces form a shallow fuel bed on the grate. By means of an adjustable nozzle, the coal is dropped by gravity and *distributed uniformly over the entire surface of the grates.*

The conveying air provides the overfire air which is, of course, a requisite of efficient combustion. This air is more intimately mixed with the coal than is possible by any other means. Entering at right angles to the flow of undergrate air through the fuel bed, the conveying air produces *maximum turbulence; another requisite of efficient and smokeless combustion.*

Applications are flexible; the stoker can be set at boiler room floor level, or on the floor above or below. It can be located at any angle in front of the boiler, and at distances of 30 feet or more from the boiler front.

The Iron Fireman Pneumatic Spreader stoker was designed to burn efficiently a wide range of such economical fuels as the lower grade bituminous coals, and also sub-bituminous and lignite coals, and to provide *a reliability of operation, physical adaptability, ease of operation,* and *low maintenance* not afforded by other types of automatic coal burning systems.

IRON FIREMAN STOKERS ARE AVAILABLE

Write for Information

To fill stoker requirements of heating and power plants converting from oil, and of essential industries, output of Iron Fireman commercial-industrial stokers has been substantially increased. Let us send you free literature on Pneumatic Spreaders and underfeed models. Iron Fireman Mfg. Co., 3613 West 106 St., Cleveland, Ohio.

IRON FIREMAN AUTOMATIC COAL STOKERS

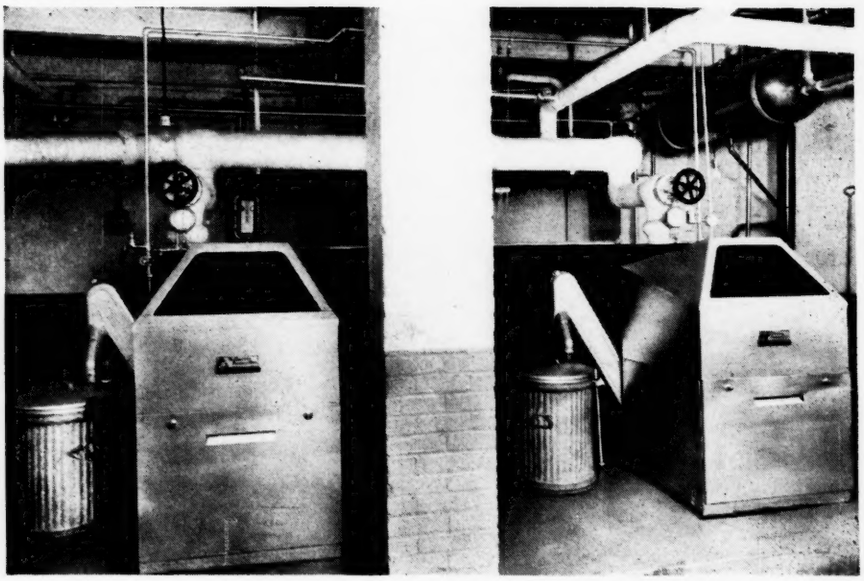


Fig. 30. Two anthracite Electric Furnace-Man units are used to heat a water utility building in Pennsylvania.

mit entrance of the stoker retort into the boiler base and, as we have seen, it might be required so as to permit a suitable clinker door. If at the same time the lowered stoker provides a usual increase in furnace volume, that would be so much to the good.

For the boiler in Fig. 38 a side setting could be arranged by cutting a square opening, with at least ½-inch clearance all around, in the boiler base. For a round or perfectly square boiler it is often practicable to use jacks to lift the boiler weight and then swing the base so it faces one side or the rear. Foundations of brick or poured concrete could replace the cast iron base if that were necessary to arrange a different stoker setting.

The vertical section, Fig. 38, calls attention to the refractory hearth used generally in smaller boilers with bituminous stokers, a point that the purchaser may wish to have explained. Anthracite stokers have a clearance all around the retort, although some larger models use a form of dumping side grates. The hearth in Fig. 38 is laid level and is made at least 2½ inches thick although many specifiers ask for four inches or more and a heavier body of refractory around the retort. The refractory materials hold the heat of the fire, and are also used to protect all exposed parts of the boiler not otherwise water-cooled, including parts of the front that may need safeguarding. Only the best of refractory products should be used for the work, because poor grades will soon break down. The space under the hearth may be filled with good cinders, coarse gravel, or broken stone or brick, well packed around windbox and retort, avoiding the use of fine sand or other material which can dry and then sift through cracks under base or around stoker parts. On larger stokers dead plates resting on supporting brick walls are generally used instead of a solid hearth, leaving open air spaces below for cooling effect.

If the boiler in Fig. 38 were using an anthracite stoker there are some recommendations on the use of baffles to assist overall efficiency, placed in the fire chamber or flue passages[1].

[1]Anthracite Industries, Inc., Chrysler Building, New York, N. Y., has published Bulletin L 38, Baffles for Stoker Fired Boilers, helpful in this connection. Bulletin M-3 from the same source offers good construction details and recommendations on designing coal bins and ash pits (See Figs. 42 and 43).

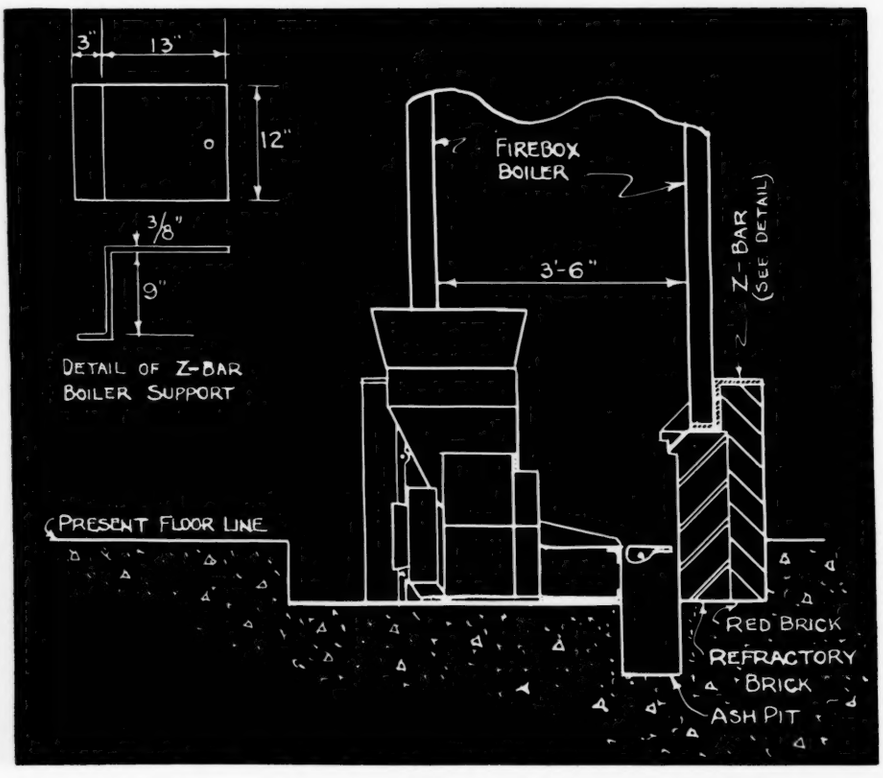


Fig. 31. Boiler construction detail for a recent Combustion Engineering conversion job where stoker was pitted so as to gain furnace volume. Boiler is given extra foundation support by use of four Z-bar support plates which throw the weight on both the refractory and regular brick. The Z-bars are ⅝ in. thick, and not ⅜ in. as mistakenly shown in the drawing.

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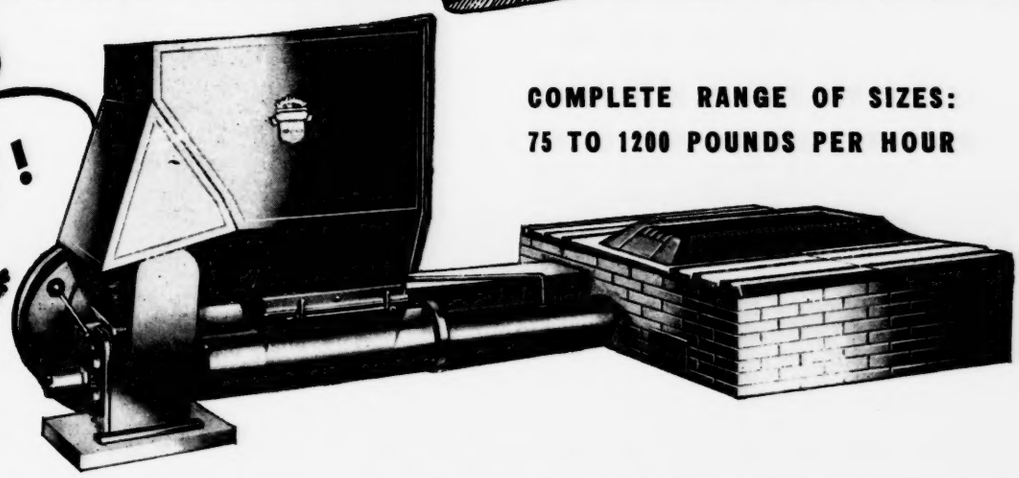
FREEMAN STOKERS

FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS

PROMPT DELIVERY!



COMPLETE RANGE OF SIZES: 75 TO 1200 POUNDS PER HOUR

Government rulings restricting fuel oil deliveries mean that most commercial and industrial oil burners must be converted to coal. Fuel oil users in your community need your assistance . . . offer you an immediate opportunity to cash in on the greatest demand that has ever existed for commercial and industrial stokers! Go after this business with Freeman: a tried and proven product that is first choice of America's foremost heating engineers. Freeman is backed by many years of satisfactory performance. Freeman has thousands of installations throughout the world; is manufactured by a pioneer leader in the stoker industry, rated AAA 1, established 1864. Write immediately for details on your territory.

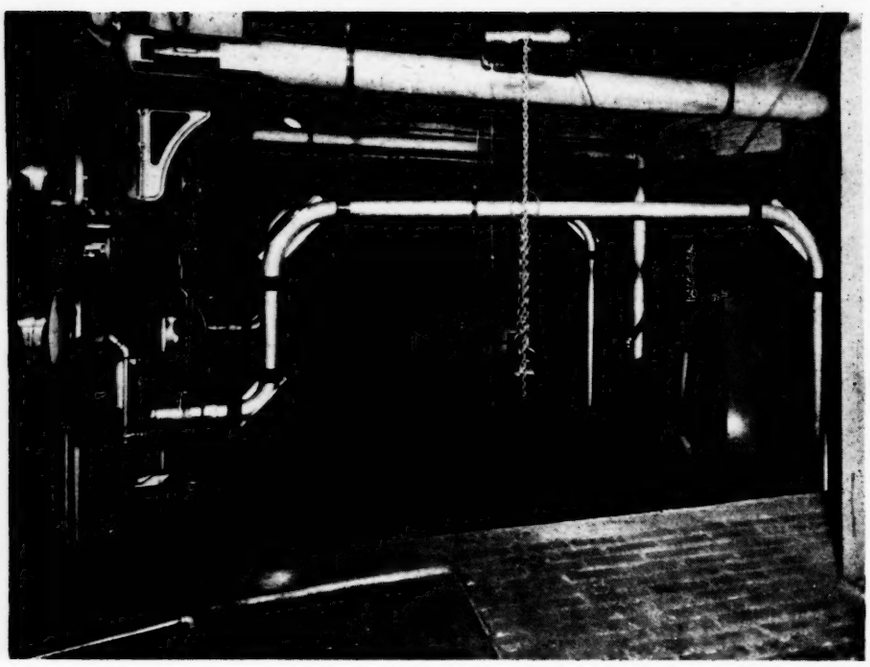


Fig. 32. Two Iron Fireman pneumatic spreader type stokers installed in a New Jersey department store to replace oil burners.

Some representative construction details for a conversion setting of a large horizontal return tube steel boiler are revealed in the drawings of Fig. 33. A pit is provided. The old fire door may be used for removing ash or clinkers. A fire brick bridge wall is constructed and the furnace space is lined on all sides with refractories. The dead plates presumably rest on a layer of refractory cement. The elevation view shows the air duct connection and the handy cleanout door to permit removing of fly ash or coal fines which may work under the retort.

Some typical conversion job drawings as specially engineered for stoker men in the field are shown in Fig. 40 and Fig. 41, as prepared for a Skelly stoker by Combustion Engineering Co., New York.

In Fig. 40 the original oil burner arrangements are revealed for an HRT boiler to be converted to stoker firing. Fig. 41 shows the alterations as planned by the engineering department. The stoker may use either hard or soft coal, but the setting is evidently intended for bituminous coal because a pit has been designated for a lower level and a slightly enlarged furnace volume. After providing a new concrete base, the furnace walls are to be reconstructed to suit the lowered foundations. A slightly deeper pit is outlined under the stoker, but this is intended as an extra space for collecting ash and clinkers and is to one side, not directly below, the stoker.

For a similar type of stoker, but with a firebox boiler, a front elevation view of the conversion details is shown in Fig. 31, as planned for an industrial building. The extra ashpit is outlined. Part of the boiler foundation support is red brick and part is fire brick. The whole furnace area is lined with fire brick, with a new bridge wall at the rear and a new front wall bricked after the stoker has been set. Four Z-shaped steel plates, ⅝-inch thick by 12 inches long, are used for boiler supports, placed near the front and the rear on each side. In some other boiler settings, however, where the side of the furnace must be on a line with the inside wall of the boiler firebox, the front boiler support has been ordered of 6-in. I-beam and long enough to extend for full bearing on the red brick foundations at both sides.

The pitting of the stoker is not an invariable method. In one conversion contract for five large 15-story apartment houses, two stokers were in-

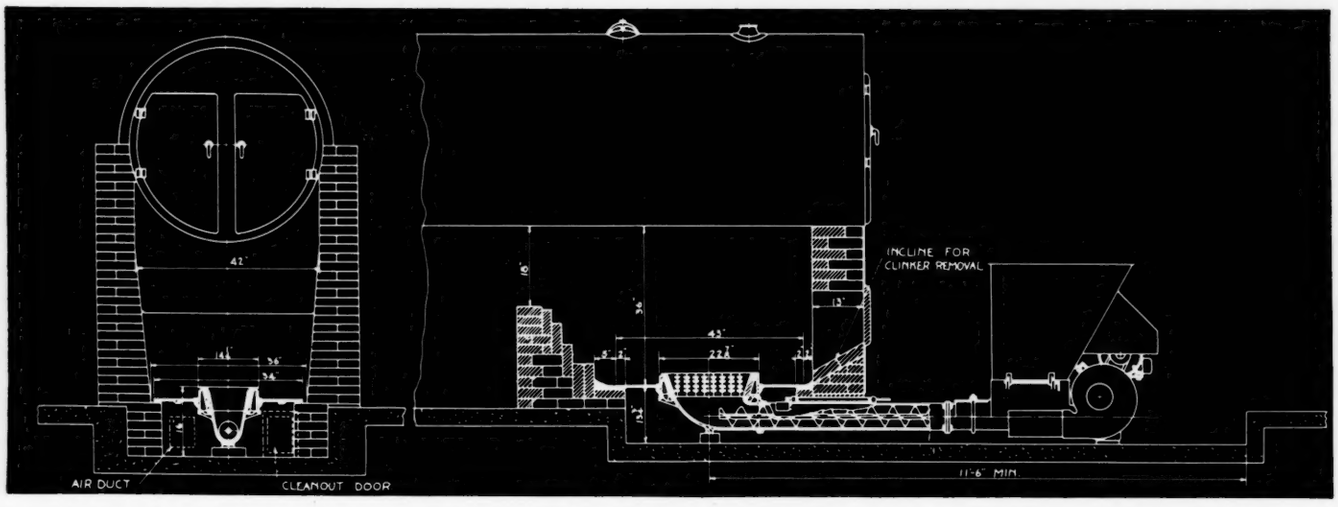


Fig. 33. Typical good furnace construction work in making a conversion from oil to stoker as planned by Whiting Company engineers. Details of furnace wall construction are shown in the side elevation; note the advantage of the pit in making ash removal convenient. Space around retort is open for a windbox, typical of the larger industrial-type stokers. The front view illustrates the position of air duct connection and clean-out door, with dimensions to various levels.

Downright DEPENDABILITY

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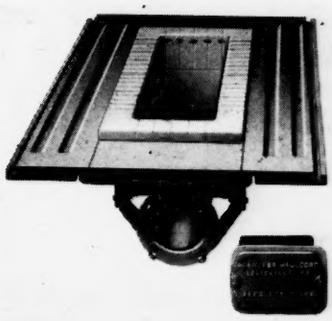
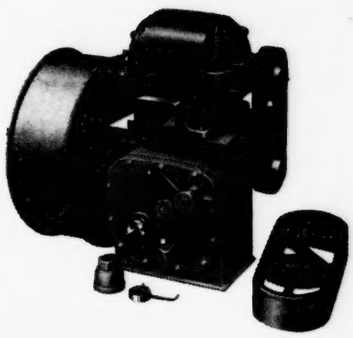


Sturdy Retort, Tuyeres, Dead Plates

Heavy cast iron assembled to allow full freedom for expansion without setting up strains; sectional tuyeres with graduated air ports for uniform air distribution. Dead Plates available in various sizes to fit almost any fire box. Cleanout frame and door furnished for plenum chamber. Highly-efficient cast steel **Coal Screw.—Coal Tube** made of 1/4" heavy steel tubing with machined steel flanges.

Simplified Hopper Construction

Open type—capacity 700 lbs. Heavy cast-iron base with obstruction trap cast in, in alignment with coal feed tube, so that clean-out cap can be removed without emptying the hopper. Sides 12 gauge steel, hinged to heavy cast-iron base, so that it can be removed easily or swung to either side, if desired, when cleaning boiler tubes. Bolted construction.



Heavy-duty Transmission and Drive

Sturdy squirrel-cage, poly-phase, sleeve-bearing 200/400 volt motor is standard equipment. Motor is protected by thermal overload element in motor starter. Clarage No. 7/8 squirrel-cage, all-steel type balanced statically and dynamically highly efficient. Transmission driven by dual V belts. Pressed steel sheaves. Fan mounted on transmission shaft, driven at motor speed. Continuous feed. Automotive-type sliding gears. 3 speeds and neutral, can be shifted under full load. All shafts run in sealed ball bearings or needle bearings. Flood lubrication of gears. All gears protected by an accessible, easy-to-replace shear pin. Shear pin collar held in place and locked by accessible set screw. Shear pin mechanism covered by dust-proof screw cap.

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Automatic Coal Stokers

Industrial Sizes: 70, 100, 150, 200, 300 & 400 pounds per hour capacity

—also built in domestic sizes

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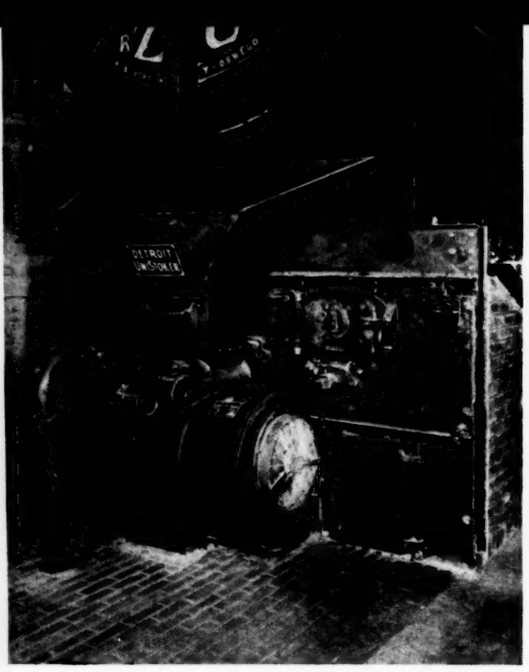

Fig. 34. Detroit UniStoker applied to a Fitzgibbons boiler in an oil to coal conversion installation in a vocational school in Minneapolis.

stalled in each building and each was set on a concrete platform 15 inches above boiler room floor level. The stokers are using anthracite rice coal and the hoppers are filled from an overhead monorail conveyor system. Thus the elevation of the stokers does not cause inconvenience in filling the hoppers, which in pitted jobs may be more handily reached. The stokers just mentioned are each capable of developing 115 hp continuously and the installations are representative of a good sizing plan. It is expected that one stoker will carry the entire heating and domestic hot water load of each building, except during the severe cold spells. The bottom of the ash dump to the side of each stoker is at floor level and that should make ash removal easier.

Some of the customary installation reminders are that the best use of heat absorption boiler surfaces should be sought, avoiding pitting when it is possible to have water walls rather than brick walls around the fire bed, avoiding a bridge wall in an HRT boiler so high that the boiler bottom is shielded unnecessarily from the radiant heat of the fire, and making sure there are no air leaks between dead plates, between dead plates and retort, and between tuyere sections. It has been recommended that ventilated hearths be used with all stokers having built-in windboxes, also to make sure that all air leaks are sealed in smoke breeching, boiler sections, openings and doors.

Heating contractors and plant engineers who are handling stokers for the first time are urged to study carefully directions prepared by the manufacturer, so as to assure themselves of every guide to good installation operation which will make the transaction a gratifying and enduring success.

Walter Sormane, sales manager, stoker division, Schwitzer-Cummins, mentions that aside from problems of locations and conveniences, there are several changes necessary to adapt the heating plant itself to stoker firing. A target is usually provided for an oil burner, which must be removed since it has no purpose in stoker firing. The brick work which formed the combustion chamber for the oil burner is often burnt or spalled beyond salvage. But sometimes the original combustion chamber works fine as a windbox for the stoker and needs only a few corrections as to size and a coat of plaster to insure that it is air tight. Most conversion installations require a bridge wall to confine the anthracite fuel bed to desired proportions. Some oil burning boilers have explosion-type doors which are not suitable for use with solid fuels since they do not provide sufficient opening for the removal of clinkers. In such cases a door and frame of suitable dimensions can be readily installed below the water legs for clinker removal. An automatic draft limiting device is usually found but where one is not, Mr. Sormane says the importance of such a device should be stressed, because best performance cannot be obtained from a stoker without some form of automatic draft control.

COMBUSTION

Since many stoker engineers and installers are now with the armed forces, there is a shortage of manpower in the stoker field. Practical heating men who may not have specialized in stoker work previously are among those being widely engaged in the work at present. Thus it happens that skilled stoker engineers are prepared to review fundamentals of combustion and installation in talks and papers to sales gatherings or technical groups, so that this new personnel may have a chance to brush-up and be better prepared to present stokers to the public.

In connection with reviewing combustion fundamentals with his own organization Herman E. Winkler, executive vice-president in charge of engineering, U. S. Machine Corp., Lebanon, Ind., recently prepared an excellent paper on the application of stokers to oil conversions. The following (up to and including page 70) is a digest of his presentation: The boiler is basically a heat catcher. It

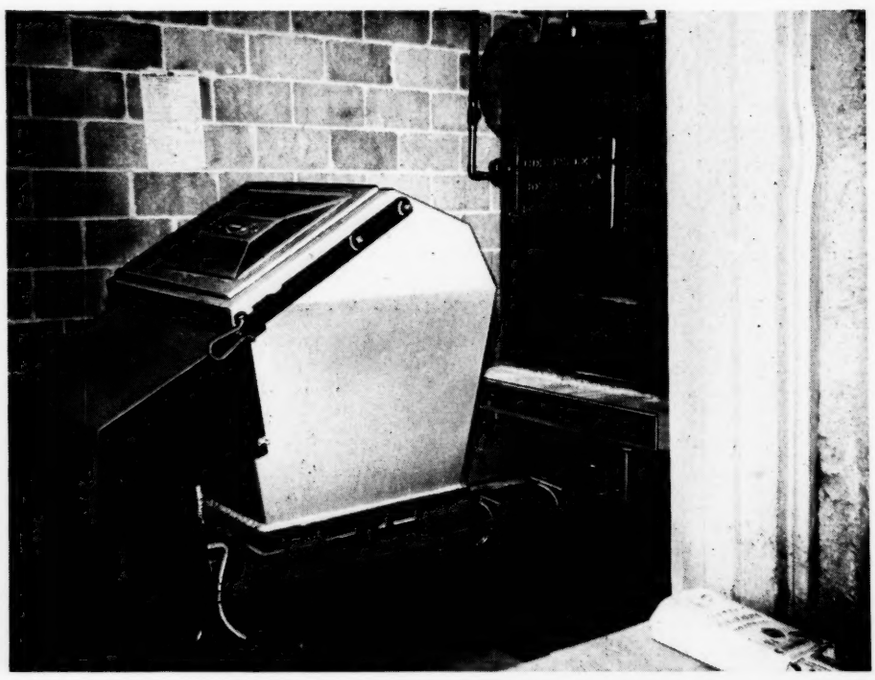

Fig. 35. Where the only available location for a bin is far removed from the boiler Schwitzer-Cummins recommends either a binfeed stoker or one with large hopper capacity as shown in this Stokol installation.

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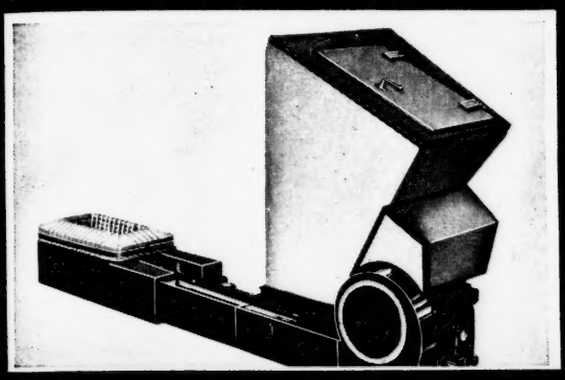

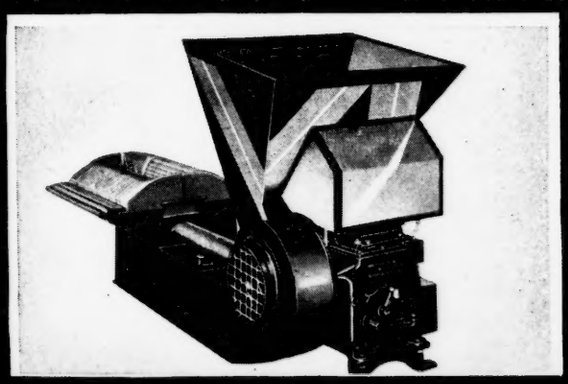

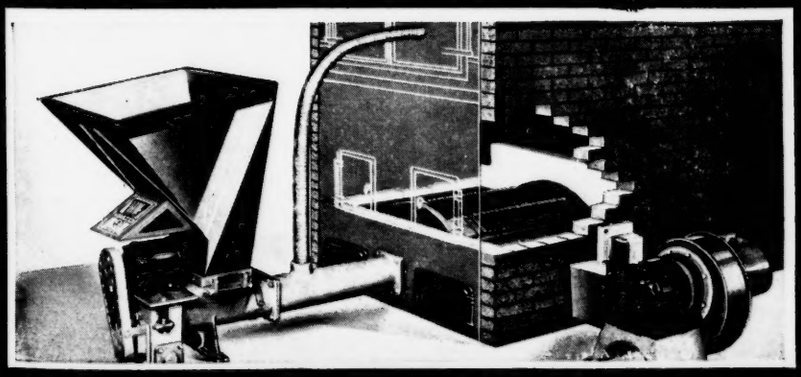

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STOKER MANUFACTURERS ASSOCIATION SMA

HOLCOMB & HOKE MFG. CO.

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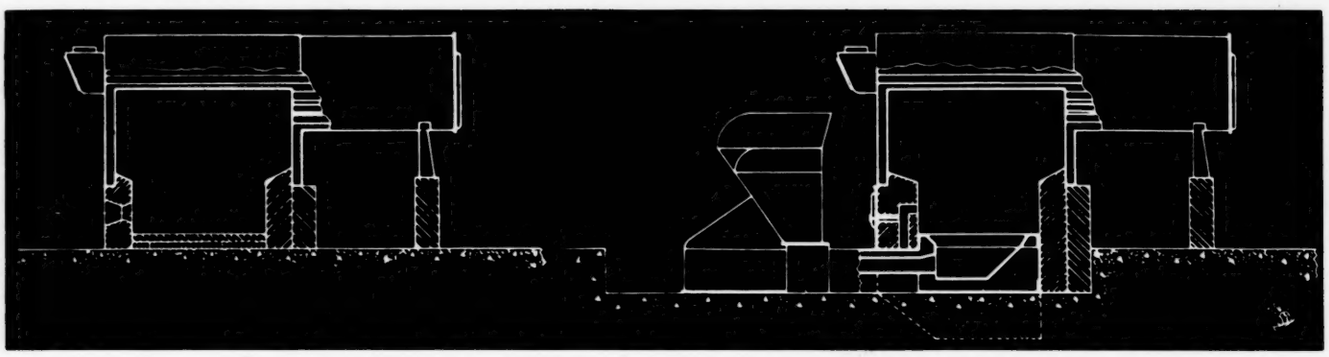

Fig. 36 (Left) and Fig. 37 (Right). Representative firebox boiler construction details before and after converting from oil firing to stoker firing. Furnace volume is retained by lowering the stoker into pit in this installation by Combustion Engineering Co. The furnace refractory walls have been wholly reconstructed.

catches heat released in the firebox, transfers it into the steam being used. This fundamental is the same with oil or coal. To enable a boiler to equal oil firing with coal, provide conditions which will allow the boiler to catch an equal amount of heat.

Combustion involves two efficiencies: (1) burning efficiency; (2) overall plant efficiency. Burning efficiency has to do only with what takes place in the firebox. Overall efficiency combines burning efficiency with boiler's ability to catch released heat.

What happens in burning is the rapid combination of a combustible with oxygen which takes place, if in the presence of sufficient oxygen, at temperatures above the ignition point of the combustible. The result of the chemical reaction is the liberation of heat and formation of the oxide of the combustible.

Perfect combustion with a typical good soft coal gives 3 2/3 lb of CO_2 and 14,600 Btu per lb, possible theoretically. Yet "carbon has the propensity of accepting partial oxidation, developing from the partial oxidation, carbon monoxide, CO, and releasing only 4,400 Btu in the reaction. Thus, anytime the conditions in a firebox permit the formation of CO, which gets away through the flue, that part of the carbon which made the CO yielded only about a third of the heat it might have, had it been reduced to CO_2."

On the other hand, the nitrogen in the air "just doesn't do anything. It will not oxidize, burn, at any temperature we can get in a firebox. It absorbs heat from the fire to raise it to the temperature of the flue gas and it waltzes on out with heat—forever lost." All that can be done about it is to keep the nitrogen so passing through to a minimum.

The four requirements actually necessary for proper combustion in fireboxes are:

(1) A high enough temperature in the firebox properly to ignite the various combustibles;

(2) More than the theoretical amount of air required to furnish oxygen to burn the combustibles. In practice this excess is a minimum of 50%. We cannot expect each atom of oxygen to find its mate in carbon during its short stay in the firebox. We lose less rapidly because of excess air than we lose through the formation of CO due to insufficient oxygen to unite with all the carbon and produce CO_2;

(3) The air and the combustible gases must be thoroughly mixed in a zone of high enough temperature to maintain ignition;

(4) Time for the "mating" process of oxygen and combustibles to take place is necessary. This demands provision of ample combustion space in firebox.

These requirements apply whether oil or coal is burned. It is well to realize how much alike are the basic problems in order to recognize more easily the need for certain differences and what is necessarily involved in the conversion of one burning equipment to the other.

Keep in mind that the CO_2 percentage in the stack gases, determined by familiar equipment, tells the practical story of *burning efficiency*. When using coal a range of between 12% and 14% is considered excellent and may be customarily obtained. Since there is 21% oxygen in the air, theo-

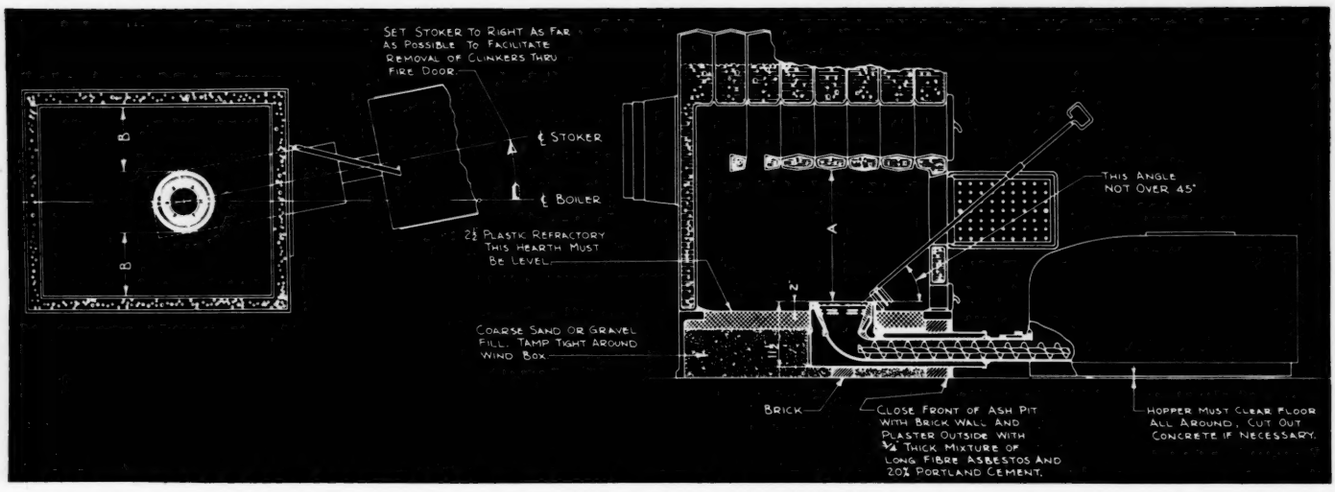
SET STOKER TO RIGHT AS FAR AS POSSIBLE TO FACILITATE REMOVAL OF CLINKERS THRU FIRE DOOR
℄ STOKER
℄ BOILER
2½ PLASTIC REFRACTORY THIS HEARTH MUST BE LEVEL
THIS ANGLE NOT OVER 45°
COARSE SAND OR GRAVEL FILL. TAMP TIGHT AROUND WIND BOX
BRICK
CLOSE FRONT OF ASH PIT WITH BRICK WALL AND PLASTER OUTSIDE WITH ¾ THICK MIXTURE OF LONG FIBRE ASBESTOS AND 20% PORTLAND CEMENT.
HOPPER MUST CLEAR FLOOR ALL AROUND, CUT OUT CONCRETE IF NECESSARY.

Fig. 38. Suggested setting for a Whiting stoker reveals how, in some instances, the stoker may be swung to one side in front of the boiler and thus make it more convenient to open the fire door and work through it. The elevation shows typical hearth construction for a cast iron sectional boiler. Stoker retort is kept at some distance from the boiler plant. It is recommended that the fill underneath the refractory hearth should be of material coarser than fine sand so as not to seep out when thoroughly dried.

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In a rug cleaning plant

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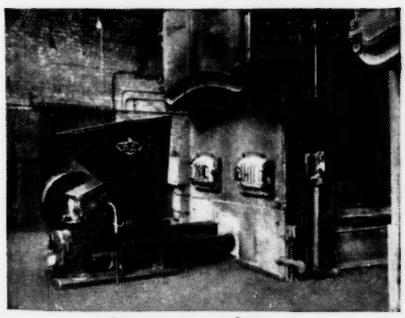
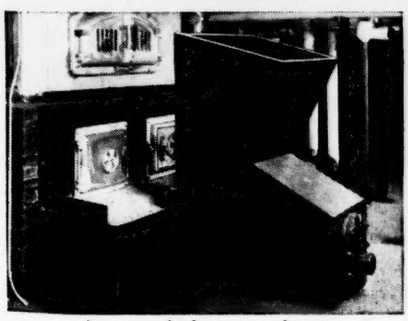


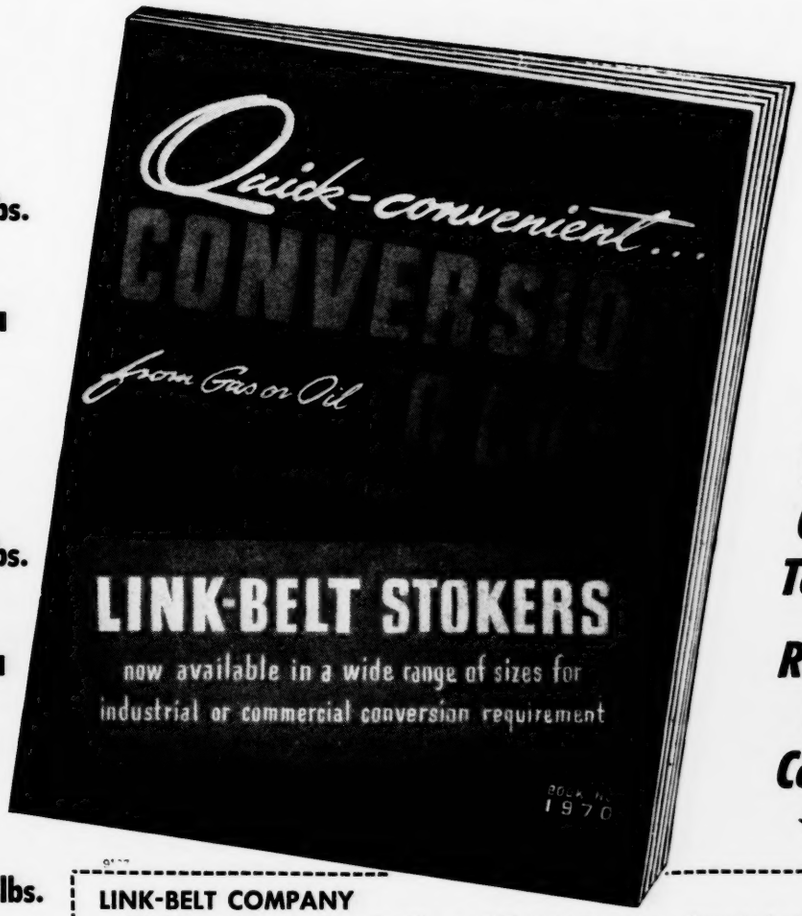
In a warehouse

650 lbs. per hour



In a defense plant

1250 lbs. per hour



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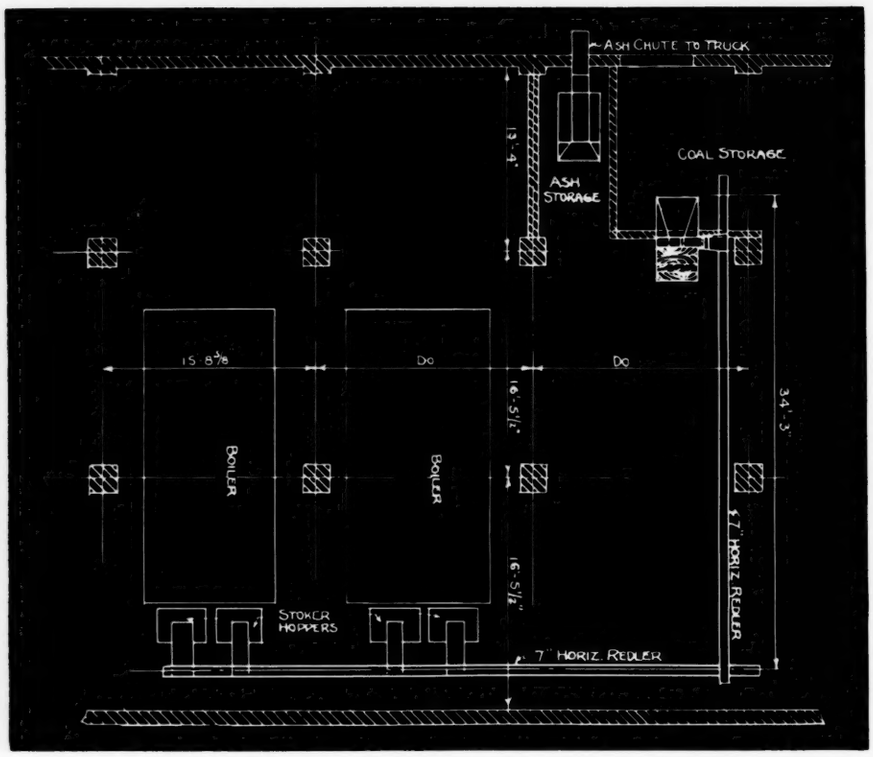

Fig. 39. Preliminary drawing for a Stephens-Adamson Mfg. Co. coal conveyor. The layout shows coal storage bin, mechanical conveyor to elevate coal to the horizontal Redler conveyor which is near the top of the boiler room and another section (lower right) which carries the coal over the chutes which drop it into the hoppers in front of the boilers. Ashes are conveyed to a bin to the left at the end of the boiler room and a mechanical elevator carries them directly to the removal truck about fourteen feet higher at grade level.

retically perfect combustion would put 21% CO_2 in the stack gases. It is necessary in practice, however, to utilize at least 50% excess air.

Now consider the difference in burning efficiency and overall plant efficiency. The fireboxes previously mentioned as to flue gas analysis might have been out in the yard with no boiler within a mile of them. No mention has been made of stack gas temperatures. Remember the boiler is the heat catcher. If it does a good job of pulling down the temperature of the gases leaving the firebox, it will have high absorption efficiency. If it does not, it will have low absorption efficiency. Keep this in mind:

(1) The flue gas analysis, CO_2 reading, indicates the *burning efficiency* of the fuel in the firebox;

(2) The stack gas temperature leaving the boiler indicates the *absorption efficiency* of the boiler;

(3) A combination of the two efficiencies, percentage of CO_2 and stack temperature, indicates the *overall plant efficiency*.

In considering points of difference between the fuels note that the heat content differs—19,000 Btu per lb for oil, with coal probably running between 13,000 and 14,000 per lb. This heat content difference must be definite to specify stoker capacities for previous oil burning capacities. Then the factor of coal residue, ash, influences firebox design, as there must be a place for ash accumulation and means provided, firedoors or otherwise, by which ash and clinkers may be removed.

High firebox temperatures are desirable with oil. This condition is undesirable with a stoker because of the difficulty arising from the handling of ash in the molten, unfused state. With coal we would like as far as possible to localize the extreme temperature to the upper part of the fire and to the combustion volume which is above the firebed. Thus a condition favorable to the solidification of (bituminous) ash into clinker, which must be handled, is approached. The fact that coal contains ash is a major point in the conversion to stoker-fired plant, requiring a firebox design which is not met with in any oil burner practice.

The need for storage space for coal is to be considered. Oil weighs about 7 lb per gal. The heat content is therefore 7 x 19,000 = 133,000 Btu per gal. Assuming coal of 13,300 Btu per lb, the heat content would be 2,000 x 13,000 = 26,600,000 Btu per ton. Then dividing 26,600,000 by 133,000 we get 200, which means that one ton of coal and 200 gallons of fuel oil are about equal in gross heat content.

Those who already know how to size an oil burner to a given load or boiler may size a stoker in the same way, roughly, by using this conversion factor. But remember in sizing a stoker, that is, in selecting its capacity for a given load, the stoker should not be figured to run continuously. The stoker size should be figured for a maximum operating time of 70%.

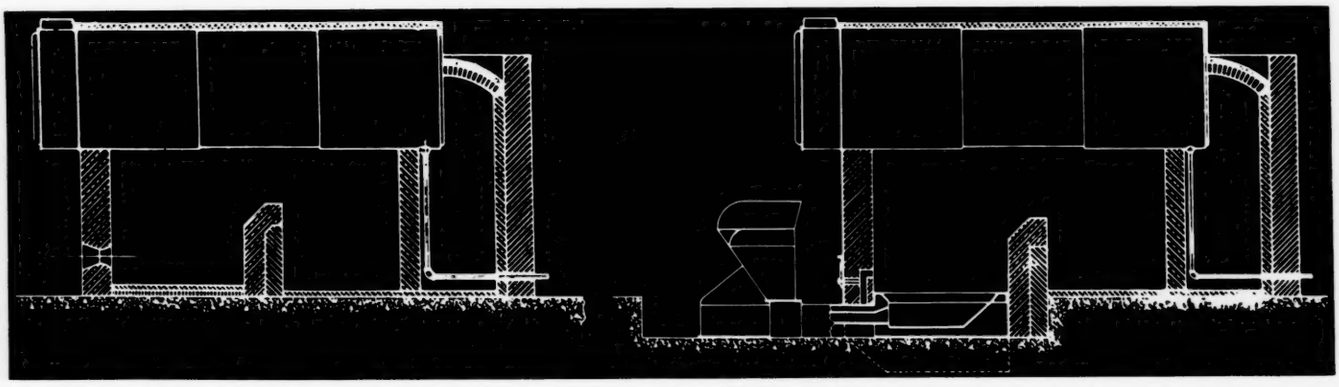

Fig. 40 (Left) and Fig. 41 (Right). Boiler furnace alteration in a horizontal return tubular boiler. Furnace volume has been retained by lowering the stoker into a 15 in. deep pit, as shown in this drawing by Combustion Engrg. Corp.

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IN THE NATION'S CAMPAIGN TO *Conserve* FUEL OIL

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Large residences now are obtaining approvals to purchase Class A stokers, creating a big opportunity for our dealers to renew activities in this market and save more fuel oil, millions of gallons, for the oil conservation program. Here are two 65-pound Models—bituminous and anthracite—sized to fit the requirements of many homes in the large home group. They will be eagerly sought, and can be had for prompt delivery.

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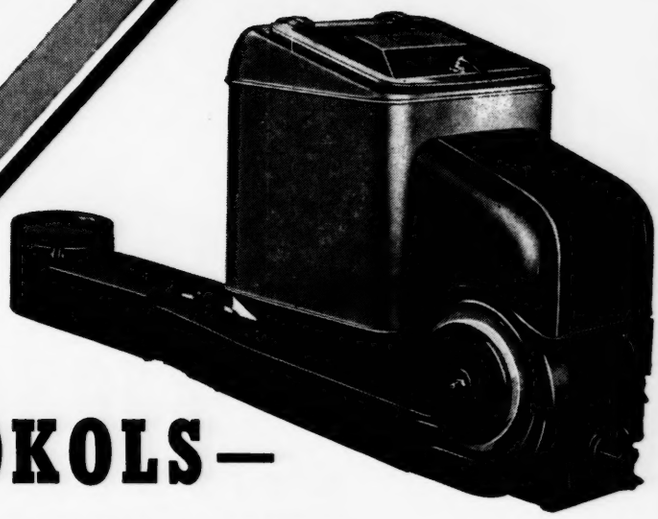

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are made 65 pounds to 1,000 pounds per hour . . . Anthracite and Bituminous

The war has made some open spots in STOKOL territories, some open places in dealers' organizations. So there's a need for additional active dealers and for individuals who can locate eligible prospects and work with existing dealers. There never was a larger market for commercial stokers, never a better opportunity to keep yourself active in a war-time necessity and make a profit if you are a heating man. Write or wire for further information. We would like to send you the STOKOL Commercial & Industrial booklet for a complete description of an outstanding stoker line.

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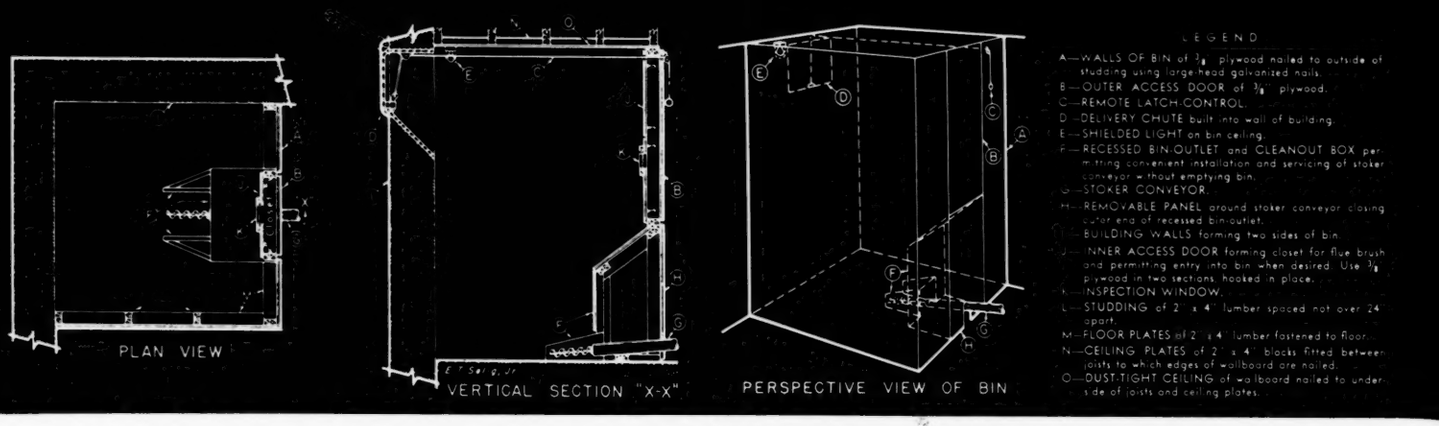

PLAN VIEW
VERTICAL SECTION "X-X"
PERSPECTIVE VIEW OF BIN
LEGEND
A—WALLS OF BIN of 3/8" plywood nailed to outside of studding using large-head galvanized nails.
B—OUTER ACCESS DOOR of 3/8" plywood.
C—REMOTE LATCH-CONTROL.
D—DELIVERY CHUTE built into wall of building.
E—SHIELDED LIGHT on bin ceiling.
F—RECESSED BIN-OUTLET and CLEANOUT BOX permitting convenient installation and servicing of stoker conveyor without emptying bin.
G—STOKER CONVEYOR.
H—REMOVABLE PANEL around stoker conveyor closing outer end of recessed bin-outlet.
I—BUILDING WALLS forming two sides of bin.
J—INNER ACCESS DOOR forming closet for flue brush and permitting entry into bin when desired. Use 3/8" plywood in two sections, hooked in place.
K—INSPECTION WINDOW.
L—STUDDING of 2" x 4" lumber spaced not over 24" apart.
M—FLOOR PLATES of 2" x 4" lumber fastened to floor.
N—CEILING PLATES of 2" x 4" blocks fitted between joists to which edges of wallboard are nailed.
O—DUST-TIGHT CEILING of wallboard nailed to underside of joists and ceiling plates.

Fig. 42. Design for a flat-bottom bin for stoker firing, as suggested by Anthracite Industries, Inc., in its Bulletin M-3.

FUEL PROBLEMS

Except where local coal mines are convenient and dependable, there are likely to be some coal supply problems during a war emergency period. Under war conditions it is possible that poorer grades of coal will be shipped, containing high ash content and less careful sizing. In practical terms, this means that in sizing his stokers the engineer should allow extra stoker capacity on account of the lack of uniformity in fuel.

If large quantities of bituminous coal are to be stored the pile should be covered tightly with well-packed small barley size or similar anthracite on the top and all sides. It is also suggested that the coal first delivered to the pile be the first withdrawn for firing.

The vast majority of coal stokers are selected with the intention of utilizing either bituminous or semi-bituminous coal or anthracite. Some models are available to burn either hard or soft coal, and in such stokers the only change necessary is to remove the spill-over side plates used for anthracite and install the dumping of dead plates used with bituminous, or vice-versa.

In selecting both stoker and coal it may be well to keep in mind that one should beware of the high cost of low prices. In selecting a stoker remember that a Class A stoker can use in a season coal costing more than the stoker itself. It therefore seems logical to invest a higher price in the better grade stoker which will conserve on fuel consumption year after year and thereby more quickly amortize the original expenditure.

In some boiler rooms one or more oil-fired units may be left for standby emergency service. In such instances it is recommended as advisable to convert first to coal the boilers farthest removed from the smoke stack. This arrangement disturbs as little as possible the uniformity of draft required for the efficient burning of oil. Where the first boiler has been converted, or where conversion of only part of the boilers is planned, one engineer recommends that the coal-fired boiler or boilers should be operated continuously at the most efficient rate of combustion. The purpose is to permit a maximum saving of oil, the goal sought by conversion. By this plan the remaining oil-burning boilers act only as auxiliary units.

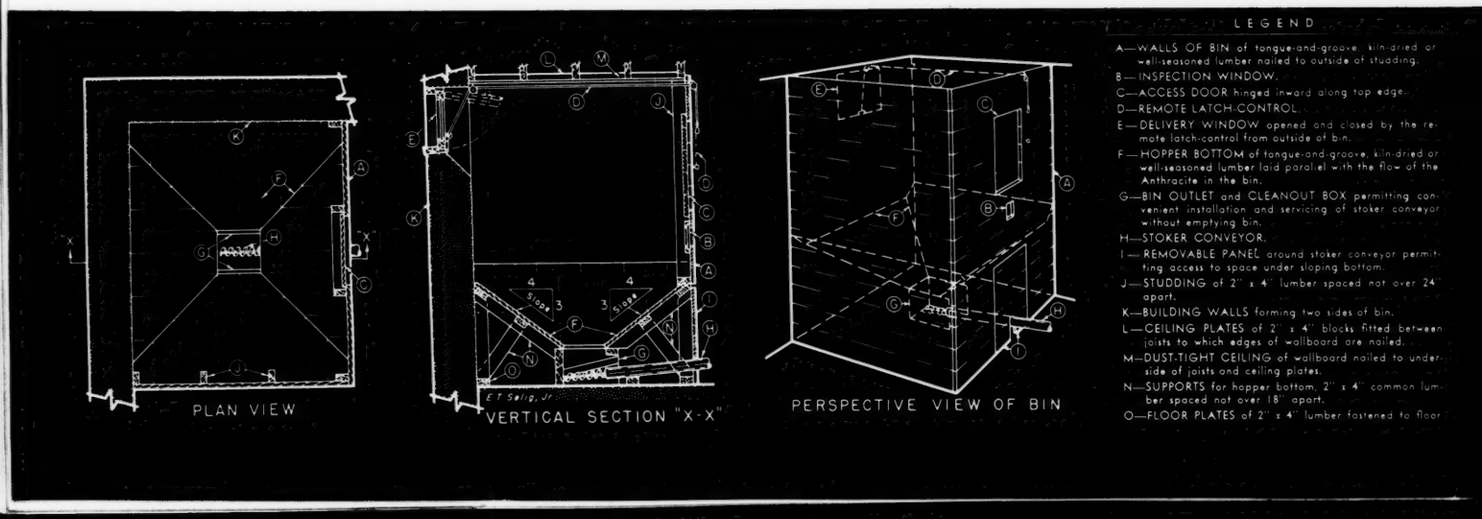
If the entire plant is converted to Class A stokers, it is recommended that coal feed rates be set so that a stoker operates for long periods and is off for short intervals. This results in lower stack temperatures due to the fact that, with stokers operating continuously at lower rates of combustion, more heat can be absorbed by the boilers.

It is believed that engineers too frequently set stoker operation at maximum capacity under the conviction that by so doing the building will always have ample heat. It may be overlooked, however, that with the stoker running for short periods followed by banking, clinkering may result which frequently burns grate bars and in some cases also burns the supports below the grate bars. This condition, found in both hard and soft coal stokers, is due to lack of air through the fire with no cooling during idle periods.

The question often arises as to whether or not blends of anthracite and bituminous coal may be used to advantage. Mixing is comparatively simple with handfiring, but may not be convenient with stokers. For large stokers an intimate mix is required and mechanical mixers are probably necessary. For smaller hopper installations it may be sufficient to mix while shoveling into the hopper, counting on further mixing by the feed screw or pusher.

According to anthracite engineers experience has demonstrated that the admixture to bituminous is beneficial when any of the following con-

Fig. 43. Design for a hopper-bottom bin for stoker firing, as suggested by Anthracite Industries, Inc., in its Bulletin M-3.


PLAN VIEW
VERTICAL SECTION "X-X"
PERSPECTIVE VIEW OF BIN
LEGEND
A—WALLS OF BIN of tongue-and-groove, kiln-dried or well-seasoned lumber nailed to outside of studding.
B—INSPECTION WINDOW.
C—ACCESS DOOR hinged inward along top edge.
D—REMOTE LATCH-CONTROL.
E—DELIVERY WINDOW opened and closed by the remote latch-control from outside of bin.
F—HOPPER BOTTOM of tongue-and-groove, kiln-dried or well-seasoned lumber laid parallel with the flow of the Anthracite in the bin.
G—BIN OUTLET and CLEANOUT BOX permitting convenient installation and servicing of stoker conveyor without emptying bin.
H—STOKER CONVEYOR.
I—REMOVABLE PANEL around stoker conveyor permitting access to space under sloping bottom.
J—STUDDING of 2" x 4" lumber spaced not over 24" apart.
K—BUILDING WALLS forming two sides of bin.
L—CEILING PLATES of 2" x 4" blocks fitted between joists to which edges of wallboard are nailed.
M—DUST-TIGHT CEILING of wallboard nailed to underside of joists and ceiling plates.
N—SUPPORTS for hopper bottom, 2" x 4" common lumber spaced not over 18" apart.
O—FLOOR PLATES of 2" x 4" lumber fastened to floor.

ditions prevail; (1) when and where the price of the small sizes of anthracite is less than that of bituminous; (2) when an undue amount of smoke is seen escaping from stack; (3) when shortage of manpower requires a fireman to perform many tasks in addition to firing; (4) when and where low volatile bituminous is not readily available due to high price or other reason, but where high volatile bituminous can be purchased at much lower prices. A mixture of high volatile with proper size anthracite will often provide the same results as low volatile coal; and (5) where domestic plants use bituminous either by hand firing or stoker.

An admixture of anthracite to exceptionally high volatile bituminous may be in excess of 25%, or when the boiler load is steady or uniform and the bituminous is medium or high volatile. Full data and recommendations are supplied by coal industry representatives. An admixture of anthracite may or may not affect the load carrying capacity of the boiler, but where the combustion space is too small to burn the volatile gas the added anthracite will definitely increase the boiler output.

CONVERSIONS FROM OIL TO WASTE HEAT

TOGETHER WITH A BRIEF DISCUSSION OF OTHER CONSIDERATIONS, INCLUDING OIL FOR STANDBY

By T. W. REYNOLDS

Cost is no longer the only criterion by which a building owner determines whether or not to convert his oil-burning plant. Of primary importance now is his own desire to be insured an uninterrupted flow of fuel as required regardless of this cost or whether or not limited by governmental regulation as to the use of oil. Further, it no longer seems wise, in most cases, where conversion in war plants within critical areas would be high in first cost or in the use of critical materials, for priorities for the critical materials required to be refused merely so that these materials might be conserved for manufacturing purposes in some other war plant, when production may be stopped for lack of oil fuel through failure to obtain materials for conversion.

It also seems that limitations on the use of critical materials for fuel storage should be relaxed somewhat, abandoning the former idea that more than a few days' supply is hoarding, to relieve the transportation system in the winter months and to avoid stoppage of work.

Carrying this idea of insuring continuity of production a bit further, the method of conversion to coal should also take into account the possibility of retaining oil as an emergency or standby fuel, even though somewhat more of critical materials may be required.* This may involve the erection of a temporary boiler plant† with second-hand coal-burning boilers and allowing the present oil-fired boiler plant to remain intact. In some cases, depending upon the location of the temporary boiler plant, even less of critical materials may be used by such a plan, and in any event the cost of the changes are usually less, interruption to plant operation nil, and the excess boiler capacity as provided in both boiler plants may soon become a desirable asset.

Judgment, naturally, should be used in all cases of conversion and a balance struck after giving due weight to all factors. For example, in a plant having four oil-fired boilers, of which only three are normally used, conversion should apply only to the three boilers, with the fourth boiler left on oil for peak loads of short duration or for use while a boiler is laid up for repairs.

Another matter which also requires careful consideration is the question of the necessity for water treatment which usually requires a certain amount of materials of more critical nature, such as plate for tanks.‡ Boilers which are second-hand or which are forced, and which in either case cannot be laid up for retubing due to lack of standby capacity, should be allowed materials for applying water treatment, but the addition of a temporary boiler plant duplicating facilities of the present plant does not require water treatment, whether or not the boilers are second hand.

Threatened shortages of fuel and of transportation have caused many plant owners to investigate the possibilities of reclaiming waste fuels, gases, or heat from processes within these plants, to the end that not only is money saved in operation, but continuity of production is assured without the use of either oil or coal as fuel.

In some cases, boilers previously fired by butane or manufactured gas have been converted to the use of combustible gases formerly going to waste. For example, in one plant manufacturing sodium lead alloy (an intermediate in the production of high octane gas), the installation of a gas surge tank, a condenser, and a liquid fuel receiver recovered process gases for use as boiler fuel within the plant, thus effecting a great saving by eliminating the cost of butane fuel as formerly used, as

*In many cases this may easily be accomplished by using combination oil and coal burners.

†This is sometimes required in any event in order to avoid interruption to existing boiler plant operation while changes are being made, and to provide room for boiler room fuel firing equipment, as well as access for coal and ash storage and handling equipment.

‡Sheet may be substituted for plate by reducing the thickness of the metal to 3/16 in. or less.

DATA ON CONVERSION IN AN INDUSTRIAL PLANT

Source of Heat	Quantity Fuel Required Yearly	No. Cars Required to Transport Fuel	Man Hours Required for Firing Fuel	Wages for Man Hours	Cost of Fuel	Cost to Maintain	Total Operating Cost	Cost of Conversion	Tons of Critical Materials to Convert	Tons of Non-Critical Materials to Convert
Oil Fuel ..	6170 Bbl.	27[1]	8,760[2]	$6.132	$11,720	$6,000[5]	$23,852	—	—	—
Coal Fuel..	1,800 Tons	36	17,520[3]	$12,264	$8,280	$6,000[5]	$26,544	$8,740[7]	14	—
Waste Heat	0	0	0[4]	0	0	0	—	$37,603[6]	18[8]	57

[1]9,000 gal. per car; [2]Regular shift, 3 men; [3]3 men for boilers plus 3 men for coal and ash handling; [4]Fuel fired by dry kiln operators in dry kilns; [5]Boiler house and steam distribution system; [6]Cost was $28,933 prior to substitution of non-critical materials; [7]Cost for 2 mechanical stokers, electric hoist and tramrail system (including supports) for coal and ash handling; [8]Weight was 53 tons prior to substitution of non-critical materials.

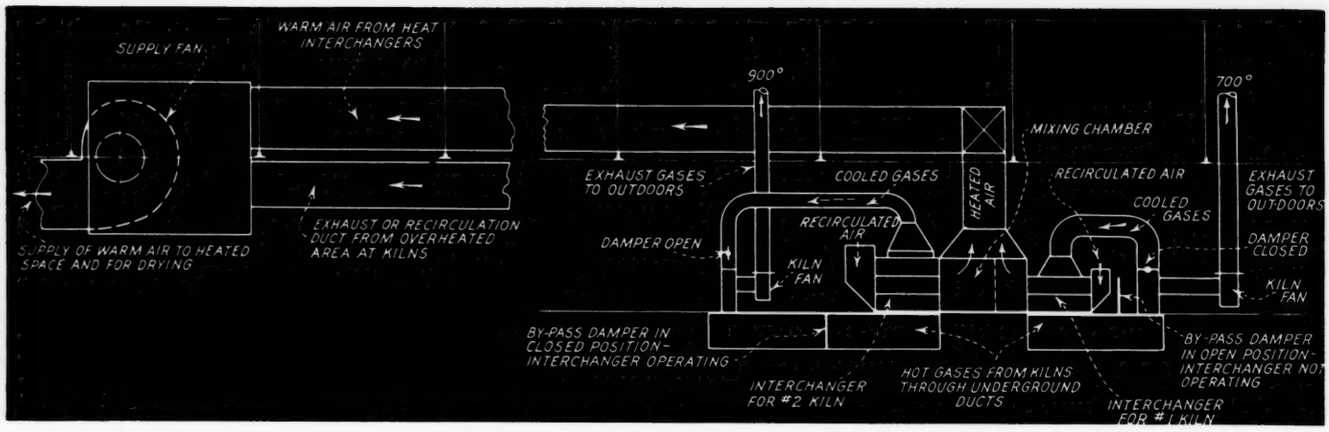


Fig. 44. Sketch of waste heat recovery system installed for heating a building formerly heated by an oil-fired steam heating plant.

well as a substantial saving in the use of tank cars required for the shipment of this gas. In the plant in mind the recoverable gases from the process comprised about 50% ethylene, 40% butane and 10% ethyl chloride.

Oil to Waste Heat

An interesting example of the many advantages often obtainable by conversion from oil fuel to waste heat rather than to coal fuel is shown in the table on page 73. Just how this was brought about is illustrated in Fig. 44, showing two oil-fired tunnel kilns (used in the manufacture of sanitary ware in the Trenton Potteries Co., Trenton, N. J.) from which the waste heat from the products of combustion and other radiant heat from the kilns was recovered by means of a heat exchanger and put to useful work in heating the building and in drying.

This system of heat recovery, designed by J. O. Ross Engineering Corp., New York City, required the installation of a heat exchanger, a supply fan with non-metallic ducts for heating the building by warm air, and fans for the exhaust of gases as cooled to from 700 to 900F after heat recovery. In this way all fuel costs for heating were entirely eliminated and any further need for the entire existing boiler plant was also eliminated, thereby releasing its equipment for the use of other war plants and making the used equipment immediately available without delay. Fuel for heating, whether of oil or coal, was also conserved, as was its transportation and the man hours and cost for operation and maintenance of the existing boiler plant and heating system.

The cost to the owner for heating (about $24,000 yearly for fuel, wages and maintenance) was saved, but it took a war to bring this saving about. As were many other plants, the owner was requested to consider conversion of steam boilers from oil to coal fuel. Confronted with a shortage of certain grades of coal and a long delay in the securing of necessary equipment required for conversion, the practicability and quantity of waste heat recovery from their kilns was investigated and found satisfactory.

As will be noted from the drawing all possibilities of heat recovery have been taken advantage of; for example, an exhaust duct leading back to the supply fan not only recirculates the building air, but also returns hot air directly from areas near the kilns so as to capture the radiant heat from the kilns and also the heat liberated from cars when removed from the kilns. These cars and their contents are at a temperature of 1800 to 2500F and although this heat was formerly liberated to the building space, it was not entirely useful heat as it was not diffused throughout the building as a whole. In fact, this heat was detrimental at times, due to overheating of this area requiring the heating of outdoor makeup air to replace the exhaust of overheated air to outdoors.

In operation the two exhaust gas fans draw the products of combustion from the kilns by underground ducts, either through the two heat interchangers, or by manipulation of dampers in accordance with building heat requirements directly without passing through the interchangers. The heat recovered by the interchangers is removed by the suction of the single supply fan and this heated air as mixed with warm air from the exhaust or recirculating duct is discharged through supply ducts to the spaces to be heated.

The studies that were made as to conversion from oil to coal fuel of the existing steam boiler plant showed that the man hours would be doubled, the number of cars for transporting fuel would be increased from 27 to 36 yearly, cost of maintenance would of course be the same, and while fuel costs would be reduced about 30%, the total cost for wages and fuel would still be 10% greater because of the doubling of wages.

The first cost of oil coal conversion was found to be only about 25% of the cost of converting to waste heat and furthermore only 14 tons of critical materials were required to effect the change. However, the cost of conversion to waste heat would be saved in about eighteen months due to the elimination of all operating costs, and again it was found that the original weight of critical materials of 53 tons could by the substitution of 57 tons of various other materials be reduced to only 18 tons of critical materials. These substitutions, of course, increased the cost of conversion, due to the increase to 75 tons in the weight of all materials used.

The interchangers were fabricated of galvanized steel sheets (stiffened and held together by structural steel angles) as sheet metal offers the most desirable means for heat transmission in the handling of air. These interchangers raised 1581 lb of air per minute from 80 to 200F. The mixing chamber was originally designed of sheet metal but it was found that asbestos cement board could be substituted. Rope-drive sheaves of wood rather than of iron were also substituted.

Further substitutions of non-critical materials were made by using cement asbestos ducts, wood members for duct hangers, a second hand by-pass damper and steel scrap for reinforcement in concrete overhead platform for support of supply fan. This platform was necessary because it was not possible to install the fan on the floor due to the necessity of an aisle passage clearance between the kilns. Wood was contemplated for this purpose, but eliminated due to scarcity of wood and the high temperatures and fire risk of wood when adjacent to the kilns.

WASHINGTON NEWS

Summarized by Loring F. Overman. Big Oil Users Will Have to Convert; No End to the Oil Scarcity Foreseen; Fuel Oil Rationing Rules are Revised.

Conservation of another 40,000,000 barrels of oil during the 1943-44 heating season through the "virtually mandatory" conversion from oil to coal of all major consumers in specified rationed areas, is to be the goal of the Conversion Policy Committee representing the six Washington, D. C. agencies concerned with the fuel rationing program.

While details of the program had not been released as we went to press, HEATING AND VENTILATING'S Washington representative was informed that the final draft would embody substantially the following provisions:

In specified areas, no consumers using fewer than 10,000 gallons per season will be required to convert heating plants from oil to coal. The areas include Florida, Georgia, North Dakota, South Dakota, Nebraska, Kansas, Missouri and the New England states.

In other rationed areas conversion is to be "virtually mandatory" for *all heating purposes with the exception of residences* housing no more than four families, or those renting out no more than four rooms. The expression "virtually mandatory" is intended to mean that conversion will be required unless the building operator can provide overwhelming evidence that conversion is impractical.

Accomplishment of the goal would raise to 100,000,000 barrels per season the total amount of oil conserved through the conversion program, savings to date having been estimated at 60,000,000 barrels.

The decision to limit conversion to major users is based on conclusions that such conversions result in greater overall savings in fuel oil with less effect upon normal patterns, including the handling and delivery of fuel.

The Conversion Policy Committee responsible for the 1943-44 program is composed of representatives of the Office of Price Administration, Petroleum Administration for War, War Production Board, Office of Defense Transportation, Solid Fuels Coordinator and the Division of Civilian Supply.

Administration of the conversion program is handled by PAW and OPA, with the responsibility for processing uses and power generation under PAW and for heating uses under OPA. By inter-agency cooperation, the services of PAW field engineers are used to investigate and certify to the local Boards as to the convertibility of commercial users.

Oil Shortages to Continue

Any likelihood that the conversion program might be abandoned during the coming season or that fuel rationing might be obviated by increased shipments via rail and pipeline appear to have been dissipated by the Conversion Policy Committee's tentative program, and by OPA's attention to plans for changes in the present fuel oil rationing program.

OPA's fuel rationing plan for 1943-44 is based on the assumption that 66 2/3% of the normal fuel oil supply for heating purposes will be available. Although transportation factors have been improved by pipeline construction, tank car diversion and drum-shipments, increased industrial use of oil cuts heavily into the totals and at least three X-factors are cited:

(1) Will the pipelines actually deliver on time?
(2) Will military requirements overdraw?
(3) Can inventories be restored during the summer season?

OPA spokesmen point out that inventory withdrawals, sometimes as high as 350,000 barrels per day, prevented more serious shortages during the current season, but that such inventories do not now exist and may not be built up in time for the 1943-44 season.

It is also pointed out that a concentrated military withdrawal to support such an operation as launching another front, could conceivably drain an entire market in a few days.

Program Crystallizes

With broad outlines of the conversion policy outlined and with a 66 2/3% of normal fixed as the likely total for heating oil stocks, programs to administer the supply and fill in the gaps were formally announced late in April. Price Administrator Prentiss M. Brown announced details of the oil rationing program on April 29, and on the preceding day Solid Fuels Administrator Harold L. Ickes announced inauguration of a Government-industry program to encourage spring and summer storage of bituminous coal.

Ignoring the possibility of a complete tie-up of major coal producing mines, Administrator Ickes announced that the objective of the campaign will be to help prevent a bituminous coal emergency next winter by:

(1) Mining and distributing the most coal possible this spring and summer so that production and transportation facilities will not be overburdened when the next heating season opens; and

(2) Provide users with adequate stocks in hand to protect themselves against delayed shipments or other wartime disruptions during the heating season.

Coal for both industrial and domestic uses is included in the campaign, in which half a dozen government agencies and a score of industry and consumer organizations have pledged cooperation.

Summer Oil Storage Encouraged

Similarly stressing summer purchase and storage, the 1943-44 oil rationing program announced by OPA will permit the use of approximately one-third of next season's coupons by July 1. Salient features of the new program follow:

(1) Beginning late in May or early in June, each householder, as well as apartment houses, hotels and all other users of heating oil, will receive by mail from local rationing boards a renewal application form. This form must be returned at once so that boards can process and mail rations during June, the month set aside in board activities.

(2) An additional feature will be the issuance of consumer reserve coupons having an aggregate value equal to about one-sixth of the individual's heating ration. These coupons will be valid for purchases any time during the heating year. The reserve coupons and those for period one will be made valid July 1 and will be used by the consumer (along with any period five coupons remaining from the present ration) to "pay for" deliveries this summer.

Mr. Brown pointed out that by making part of the new coupons valid July 1, he was enabling householders to fill their tanks during the

summer, and dealers to follow their normal delivery schedules. This will free commercial storage facilities and permit the stockpiling of millions of additional gallons in preparation for cold weather next fall and winter. A further benefit will be to spread the delivery load of fuel oil dealers, many of whom are severely handicapped by manpower shortages and difficulty in maintaining truck fleets.

(3) No ration allowances will be decreased unless at the request of the applicant, and allowances for some smaller homes will be increased.

The basic rations of very large homes will also be raised somewhat by increasing the maximum amount of the so-called "area ceiling" that may be heated. This will be accomplished by increasing from 2000 sq ft to 3000 sq ft the maximum area which a single person is permitted to heat. The amount of floor area which is added for each additional person occupying a house will remain unchanged, namely 600 sq ft for the second person, plus 300 sq ft for each additional person.

(4) The "heating period" system will be retained in modified form. Rations will be allotted on the basis of five heating periods but there will be a more generous overlap of the validity dates of coupons, each period's coupons remaining valid through the following period. This arrangement, the Administrator said, should eliminate the problems the industry encountered during the past winter in scheduling deliveries. Retention of the five periods will also permit speedy and equitable upward or downward adjustment in rations in line with supply and weather conditions.

(5) Simplification of the coupon system and introduction of ration banking certificates for all rations of more than 20,000 gallons, whether for heating or non-heating purposes, is expected to reduce by 70% the bookkeeping required of industry. Coupons will be eliminated entirely in the group subject to ration banking, and unit values of householders' coupons will be raised to facilitate quantity deliveries.

The rationing program will apply to the same areas covered last season—the 30 East Coast and Middle Western States; Washington, Oregon and western Idaho. There is no intention to extend rationing to other areas.

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With the conversion policy fixed and both oil rationing and solid fuel summer storage campaigns under way as a result of joint action of all Washington agencies involved, it may be anticipated that early steps will be taken to make necessary conversion equipment available.

The Plumbing and Heating Division of WPB reports that the present market for grates has eased considerably; Class A stokers are generally available in 30 days; Class B stokers (residence type) are practically off the market and their manufacture is prohibited; stokers of large size, available only with approved priority ratings, require from 16 days to four months to deliver, depending upon size.

Fuel and ash conveying equipment supplies are tight. Small and medium sized units can be procured with some difficulty, but larger sizes result in augmented delivery problems. While WPB is pledged to assist in making necessary conversion equipment available it is urging that, wherever possible, makeshift equipment for ash and coal handling be utilized until metal is less sorely needed for military purposes.

Class A Stokers Re-defined

To clarify the term "Class A stoker," quoted in WPB Limitation Order L-75, which permits manufacture and shipment when applicants receive approval on Form PD-668, WPB issued Interpretation No. 1 to the Order on April 13. In the Order a Class A stoker is defined as one which has a grate area of 36 square feet or less, and a coal feeding capacity in excess of 60 pounds per hour. Interpretation 1 to the Order states that the grate area means only the live grate and excludes side dump plates. Also "coal feeding capacity" means the coal feeding capacity performance of a stoker with a commonly used stoker coal.

FHA Joins Conservation Parade

As its part in the national drive for fuel economy, the Federal Housing Administration announced on April 24 establishment of a delayed payment plan for loans insured under the Title I program to finance fuel conservation installations this spring and summer.

FHA has notified the 5,000 private lending institutions authorized to operate under Title I that initial payments on loans made between April 20 and September 1 may be deferred until November 1, 1943, if the entire proceeds are used for the conversion of heating equipment to the use of other fuels, for the application of insulation within existing structures, or for installation of storm windows, storm doors or weatherstripping.

Under Title I, loans for heat conservation measures are available through lending institutions in amounts up to $2,500 and are payable in monthly installments over as long as 36 months. The Board of Governors of the Federal Reserve System has exempted loans for these purposes from its restrictions on consumer credit. Similarly, the construction involved in converting oil or gas burning furnaces to the use of other fuels or in installing inside insulation, weather-stripping, storm doors, or storm windows may be undertaken without authorization from the War Production Board.

Transportation Efforts Continue

Although several Washington agencies are joining in stressing conservation of restricted fuel oil stocks, efforts to increase shipments to the East Coast are not being neglected.

On April 16 the Office of Defense Transportation revealed that nearly 1,100 oil-laden tank cars are being moved daily out of Norris City, Ill., temporary northern terminus of the Big Inch pipe line being constructed from Texas fields to the Eastern seaboard. Norris City loadings, shortening by hundreds of miles the haul by tank cars, is considered responsible for raising the daily average tank car movement to 922,467 barrels.

To supplement the deliveries of the Big Inch line, construction was started April 20 on the Little Big Inch, a 20-inch line to run 1,476 miles from the Beaumont-Houston area to the New York harbor area, carrying 235,000 barrels daily. The line is scheduled to be completed about December, 1943. It is contemplated the first section of the line will begin delivery of petroleum products to Seymour, Ind., in October of this year. The eastern section of the line will parallel the route of the 24-inch line now nearing completion.

With two lines under way, proposals to construct a 16-inch line from Lubbock, Texas, to the vicinity of Drumright, Oklahoma, to connect with existing pipelines feeding the middle western refining centers, are being studied by PAW. According to Deputy Petroleum Coordinator Ralph K. Davies, the pipeline proposal calls for the private financing of approximately 383 miles of new lines with a capacity of 54,000 to 116,000 barrels daily, at a cost of approximately $7,000,000.

In addition to pipelines, the program of converting Mississippi river steel barges to petroleum carriage continues, with from three to five units completed and put into service weekly. The first three barges, carrying a total of 1,760,000 gallons of

heating oil, moved out of Dubuque, Iowa, April 8, bound for Minneapolis.

Fans and Blowers

Users of portable electric fans are assured of the maintenance of such equipment, insofar as service depends upon the supply of repair and replacement parts, through provisions of General Limitation Order No. L-176 (Domestic and Commercial Electric Fans) as amended recently. Manufacturing of certain repair and replacement parts on a limited basis is provided for in the revised order, easing previous restrictions.

Production of electric fans has been limited to marine types for shipboard use since September 5, 1942. At the same time, sales of all fans in manufacturers' hands were prohibited except upon specific authorization of the War Production Board.

Fans may only be produced in fulfillment of preferred orders for use on combat or merchant vessels and in accordance with the latest Navy Department and Maritime Commission specifications. Latest specifications are now stated in the order as: Navy, Nos. 17-F-6 and 17-F-13; Maritime, Nos. 17-MC-5 and 17-MC-8. Fans so produced may be transferred without special authorization.

Definition of "Electric Fan" in L-176 has been expanded to include the wall type propeller fan having a blade diameter of less than 17 inches, and any ceiling fan. Provisions of the order now apply to these types as well as to portable electric fans.

Householder sizes of centrifugal type air boosters or underfire coal burning fans used in connection with furnaces and now in the hands of dealers have been released for distribution by the War Production Board in an amended General Limitation Order L-280.

Specifically the amended order releases for installation in connection with new or existing heating furnaces all new air boosters or fans in inventories of dealers that have a capacity of 2,500 CEM and less with motors of one-quarter HP and less.

These items originally were frozen for use in war housing projects. They are released today because they are too small to be installed with the heating units in the housing projects now planned or under construction.

Heating for Civilians

To expedite priority applications for new plumbing and heating equipment for civilian residential use, Form PD-851 has been issued by WPB's Plumbing and Heating Division. The form can be obtained at WPB Field Offices and is to be filed by the occupant or owner of a private dwelling who desires priority assistance for the purchase of new plumbing, heating, domestic cooking equipment (except electrical), or material, the sale of which is restricted by Limitation Order L-79.

This new form, which will be of mutual assistance to the purchaser, plumber and dealer, further simplifies the procedure so that applications will be handled in the Field Offices, which are more familiar with conditions in local areas.

The instructions indicate when the form should or should not be used. Form PD-851 should not be used to obtain plumbing and heating equipment for repair or replacement of existing equipment which is worn out, damaged or destroyed. Repair or replacement procedure should be handled by the material suppliers, who are assisted by Order P-84.

Form PD-851 should not be used to acquire any item which is rationed by OPA. The local rationing board should be consulted concerning rationed items.

When applying on Form PD-851, the ultimate consumer (occupant or owner) should file two copies with his nearest WPB Field Office and keep one copy for his own records.

The civilian was also considered at a meeting of members of the Plumbing and Heating Distributors Industry Advisory Committee and government officials late in April. Committee members urged the establishment of a preference rating sufficiently high to enable the distributor to obtain repair parts and complete replacement units from the manufacturer.

They also urged that certifications to obtain repair parts call for signature by the consumer only. This certification would be retained in the files of the person selling the repair part to the consumer.

The members also recommended that certification covering a complete replacement unit be strengthened and the order so written that this certification would be forwarded to the distributor, who would retain it in his file for possible inspection by the WPB Compliance Division. It was suggested that such certifications be signed by consumer and installer, and that complete replacement units for which this certification is necessary should be enumerated in a definite list which should be part of a formal WPB order.

APRIL WASHINGTON NEWS HIGHLIGHTS

Editor's Note: In addition to its monthly summary of Washington news, HEATING AND VENTILATING publishes a digest of the month's Orders, Amendments and press releases of particular interest to the industry. Complete copies of the releases or publications can be secured by writing U. S. Information Center, 1400 Pennsylvania Avenue, Washington, D. C., mentioning the date of the release and the reference number. The first figure in each listing is the date in April the release was issued.

28th — PETROLEUM PENALTIES STREAMLINED. Streamlining of action against those who violate orders, directives or regulations of the Petroleum Administration for War was announced today by PAW Administrator Ickes. OWI-1718.

27th — FUEL CONVERSION LOANS DEFERRED. FHA announces details of plan for delayed payment of loans which finance conservation installations. OWI-1665.

26th—REFRIGERATION PRICE LEVELS SET. Methods of pricing used refrigerating and air conditioning equipment of less than 25 horsepower, which is sold as part of WPB program to convert such equipment for use in war industries, were announced by OPA with issuance of amendment 162 to Supplementary Reg. 14, effective May 1. OPA-2339.

25th—CLAY HEATERS READY SOON. Ceramic space heaters and ceramic stoves may soon be available for American purchasers. WPB-3289.

24th — 469 MERCHANT SHIP CONTRACTS. Contracts for construction of 469 merchant ships, including 189 new design Victory ships and 206 high speed tankers, were announced today by U. S. Maritime Commission. Release names eight successful contractors. OWI-1675,

24th — VALVE ORDER MODIFIED. Limitation Order L-252, issued in January to reduce types of gate, globe, angle cross and check valves, has been revised to eliminate certain specifications of physical properties of some of steels contained in original order. WPB-3301.

17th—CONVERSION GRATES PRICED. Specific dollars-and-cents ceilings for recently developed grates to be used in converting rectangular heating plants from oil to coal were announced by OPA in Amendment 2 to Regulation 236, effective April 23. OPA-2282.

14th — REFRIGERATION ORDER MODIFIED. Amendment of General Limitation Order L-38, issued today, modifies restrictions on deliveries of refrigerating and air conditioning machinery and equipment covered by the order. WPB-3189.

13th — TESTS TO SEEK NEW COLLOIDAL COAL-OIL FUEL. Exhaustive tests to develop fuel composed of mixture of oil and coal, for years goal of research chemists and engineers, have been started by U. S. Bureau of Mines and the Atlantic Refining Co., in industrial boiler of the company at Philadelphia refinery. OWI-1628.

7th — Q. AND A. ON A-C EQUIPMENT ORDER. A question and answer discussion of Conservation Order L-38 (refrigerating and air conditioning equipment and water coolers as amended March 27, 1943, was issued today by WPB. WPB-3100.

6th — COPPER RESTRICTIONS AMENDED. Copper Order M-9-c was amended by WPB today and now prohibits use of copper in fans, except as permitted by Order L-176; and in air-conditioning and refrigerating equipment, except as permitted by Order L-126 and L-38.

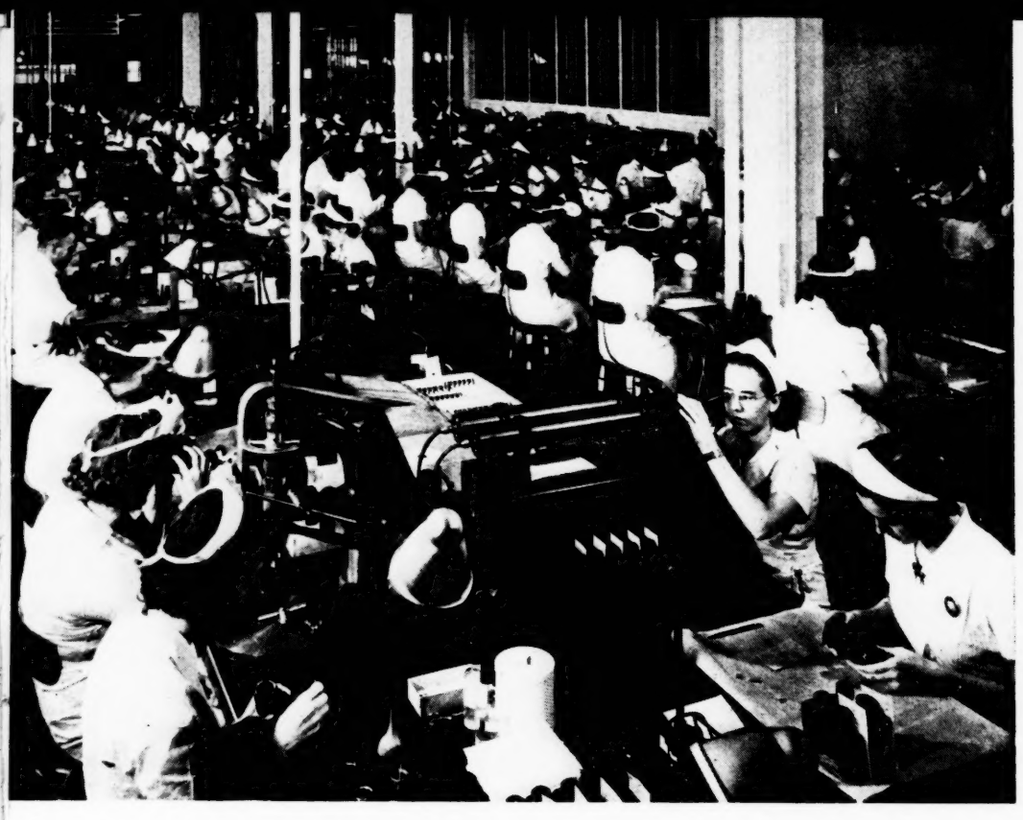

Fig. 1. Under perfectly controlled atmospheric conditions, both air conditioning and electric air cleaners protect these binoculars from dust, lint, and other air-borne dirt particles, during assembly of the delicate devices. Wearing freshly starched white uniforms the girls shun facial makeup because even a flake of powder on the sensitive lens would impair vision.

Spot Air Conditioning Speeds War

PROFITS IN AIR
HOW INDUSTRIAL PLANTS PROMOTE PROCESSES BY CONTROL OF AIR CONDITIONS

Air Conditioning's part in helping to win the war is not confined to the huge conditioned blackout plants; perhaps even more interesting are the numerous applications of small units to highly specialized and vital operations not even dreamed of a few years ago.

By L. W. CLIFFORD

Air Conditioning Dept., Westinghouse Electric & Mfg. Co., East Springfield, Mass.

WITH sleeves rolled up, air conditioning is increasingly an efficacious tool for speeding war production. Applications range from specialized use in aviation trainers and chilling shot, to broad industrial fields such as cooling welding-electrodes or conditioning metallurgical laboratories. The following typify and give some of the flavor of the present usefulness of spot air conditioning.

Trainer Buildings

As a part of the extensive program of training the thousands of student fliers in the various branches of our armed services, simulated flight training is very important. Many hours must, of course, be spent in the air in actual flight during the basic and advanced training periods. Likewise, each student flier must put in long hours on the ground in the study of mechanics, aerodynamics, navigation and the fundamental study of the instruments and controls that make controlled flight possible.

For these latter studies, particularly, many unique devices have been developed.

So that the study and use of the plane's controls and instruments might be conducted in complete safety on the ground the Link trainer has been developed. In this device the student pilot can actually go through the complete cycle of a flight from takeoff to landing without actually leaving the ground.

Likewise for the study of celestial navigation, special rooms are required where the celestial bodies and their position and movement can be studied and where in complete darkness, if desired, the student pilot makes synthetic flights, guided only by these same stars and planets.

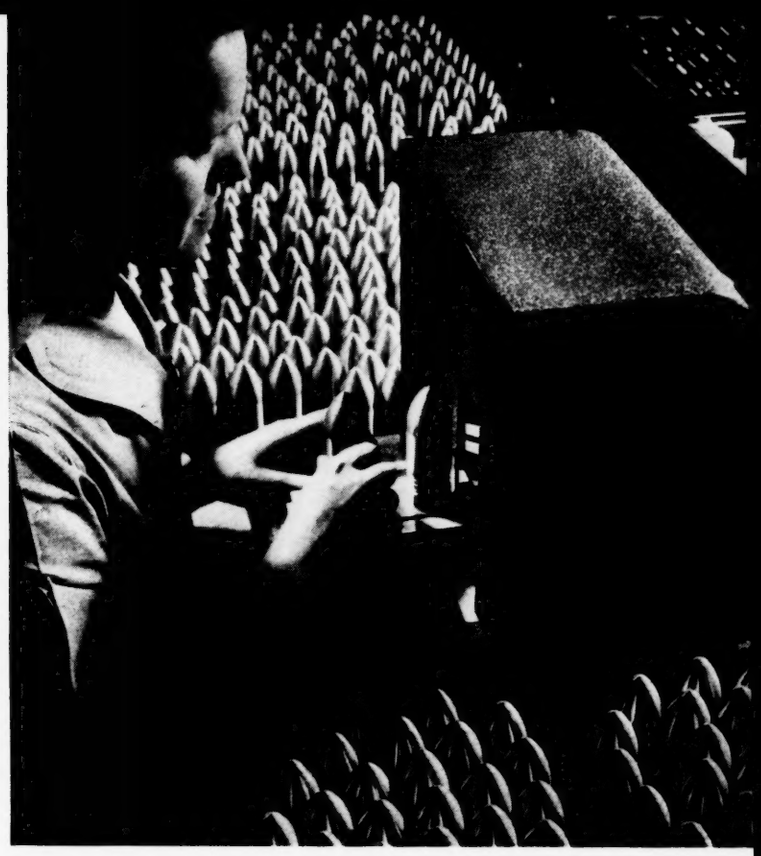

Fig. 2. War production requires air conditioning in many industrial processes for maximum output.

At air bases and flying fields throughout the country, buildings have been built and others are now under construction to house these Link trainers, either singly or in batteries, for this phase of their training or for the study and practice in celestial navigation.

Unless the Link trainer and celestial navigation buildings are air conditioned some serious problems arise. Some of the difficulties encountered when, without air conditioning, the room temperature and relative humidity values rise to extremely high levels include: (1) Instruments will not act consistently; (2) efficiency and reaction speed of the student are lessened; and (3) the hazard of perspiration damage to the controls and instruments is greatly increased.

Control Tower

At all air fields one of the principal nerve centers of field operations is the radio control tower. This is a large room, completely enclosed in glass from a height of 48 in. above the tower room floor to allow clear visibility in all directions.

Usually this tower is above one of the hangar buildings or else is supported on a structural framework at a height of about 50 ft above the ground. From this tower all plane traffic is controlled by means of radio communication. Permission to take-off and land must be obtained from the tower officer, as well as instructions as to runway to use for planes leaving or arriving. In bad weather the tower officer renders invaluable assistance to pilots having difficulty in locating the field and in landing.

Completely unprotected from the sun and with walls glassed in, the control towers develop very high internal temperatures, especially in the South. Regulations require that the door be kept locked at all times and the expensive and sensitive instruments and equipment make it impractical to use opened windows for ventilation.

As a result, air conditioning again provides the answer to the problems of making possible the continued efficiency of the human equation and consistent and reliable operation of the instruments and equipment in the control tower.

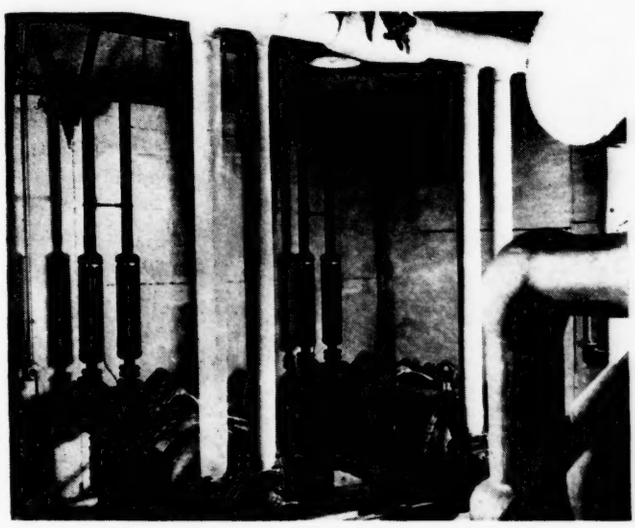

Fig. 3. Air conditioning compressors installed in basement of modern war industry building.

Metallurgic Spectrograph Rooms

In plants where metals are utilized in any appreciable quantity the laboratories are constantly testing metals as received from the supplier or as they are utilized for fabrication, so as to make sure that they meet specifications, particularly as to the required content of nickel, chromium, or other alloys.

A considerable length of time is required in making a normal chemical analysis of a metal sample to obtain both qualitative and quantitative test results. However, by means of an ingenious device called a spectrograph these analyses can be quickly made. Small electrodes are first molded from the metal to be analyzed. An electric arc is drawn between these

summer, and dealers to follow their normal delivery schedules. This will free commercial storage facilities and permit the stockpiling of millions of additional gallons in preparation for cold weather next fall and winter. A further benefit will be to spread the delivery load of fuel oil dealers, many of whom are severely handicapped by manpower shortages and difficulty in maintaining truck fleets.

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To clarify the term "Class A stoker," quoted in WPB Limitation Order L-75, which permits manufacture and shipment when applicants receive approval on Form PD-668, WPB issued Interpretation No. 1 to the Order on April 13. In the Order a Class A stoker is defined as one which has a grate area of 36 square feet or less, and a coal feeding capacity in excess of 60 pounds per hour. Interpretation 1 to the Order states that the grate area means only the live grate and excludes side dump plates. Also "coal feeding capacity" means the coal feeding capacity performance of a stoker with a commonly used stoker coal.

FHA Joins Conservation Parade

As its part in the national drive for fuel economy, the Federal Housing Administration announced on April 24 establishment of a delayed payment plan for loans insured under the Title I program to finance fuel conservation installations this spring and summer.

FHA has notified the 5,000 private lending institutions authorized to operate under Title I that initial payments on loans made between April 20 and September 1 may be deferred until November 1, 1943, if the entire proceeds are used for the conversion of heating equipment to the use of other fuels, for the application of insulation within existing structures, or for installation of storm windows, storm doors or weatherstripping.

Under Title I, loans for heat conservation measures are available through lending institutions in amounts up to $2,500 and are payable in monthly installments over as long as 36 months. The Board of Governors of the Federal Reserve System has exempted loans for these purposes from its restrictions on consumer credit. Similarly, the construction involved in converting oil or gas burning furnaces to the use of other fuels or in installing inside insulation, weather-stripping, storm doors, or storm windows may be undertaken without authorization from the War Production Board.

Transportation Efforts Continue

Although several Washington agencies are joining in stressing conservation of restricted fuel oil stocks, efforts to increase shipments to the East Coast are not being neglected.

On April 16 the Office of Defense Transportation revealed that nearly 1,100 oil-laden tank cars are being moved daily out of Norris City, Ill., temporary northern terminus of the Big Inch pipe line being constructed from Texas fields to the Eastern seaboard. Norris City loadings, shortening by hundreds of miles the haul by tank cars, is considered responsible for raising the daily average tank car movement to 922,467 barrels.

To supplement the deliveries of the Big Inch line, construction was started April 20 on the Little Big Inch, a 20-inch line to run 1,476 miles from the Beaumont-Houston area to the New York harbor area, carrying 235,000 barrels daily. The line is scheduled to be completed about December, 1943. It is contemplated the first section of the line will begin delivery of petroleum products to Seymour, Ind., in October of this year. The eastern section of the line will parallel the route of the 24-inch line now nearing completion.

With two lines under way, proposals to construct a 16-inch line from Lubbock, Texas, to the vicinity of Drumright, Oklahoma, to connect with existing pipelines feeding the middle western refining centers, are being studied by PAW. According to Deputy Petroleum Coordinator Ralph K. Davies, the pipeline proposal calls for the private financing of approximately 383 miles of new lines with a capacity of 54,000 to 116,000 barrels daily, at a cost of approximately $7,000,000.

In addition to pipelines, the program of converting Mississippi river steel barges to petroleum carriage continues, with from three to five units completed and put into service weekly. The first three barges, carrying a total of 1,760,000 gallons of

heating oil, moved out of Dubuque, Iowa, April 8, bound for Minneapolis.

Fans and Blowers

Users of portable electric fans are assured of the maintenance of such equipment, insofar as service depends upon the supply of repair and replacement parts, through provisions of General Limitation Order No. L-176 (Domestic and Commercial Electric Fans) as amended recently. Manufacturing of certain repair and replacement parts on a limited basis is provided for in the revised order, easing previous restrictions.

Production of electric fans has been limited to marine types for shipboard use since September 5, 1942. At the same time, sales of all fans in manufacturers' hands were prohibited except upon specific authorization of the War Production Board.

Fans may only be produced in fulfillment of preferred orders for use on combat or merchant vessels and in accordance with the latest Navy Department and Maritime Commission specifications. Latest specifications are now stated in the order as: Navy, Nos. 17-F-6 and 17-F-13; Maritime, Nos. 17-MC-5 and 17-MC-8. Fans so produced may be transferred without special authorization.

Definition of "Electric Fan" in L-176 has been expanded to include the wall type propeller fan having a blade diameter of less than 17 inches, and any ceiling fan. Provisions of the order now apply to these types as well as to portable electric fans.

Householder sizes of centrifugal type air boosters or underfire coal burning fans used in connection with furnaces and now in the hands of dealers have been released for distribution by the War Production Board in an amended General Limitation Order L-280.

Specifically the amended order releases for installation in connection with new or existing heating furnaces all new air boosters or fans in inventories of dealers that have a capacity of 2,500 CEM and less with motors of one-quarter HP and less.

These items originally were frozen for use in war housing projects. They are released today because they are too small to be installed with the heating units in the housing projects now planned or under construction.

Heating for Civilians

To expedite priority applications for new plumbing and heating equipment for civilian residential use, Form PD-851 has been issued by WPB's Plumbing and Heating Division. The form can be obtained at WPB Field Offices and is to be filed by the occupant or owner of a private dwelling who desires priority assistance for the purchase of new plumbing, heating, domestic cooking equipment (except electrical), or material, the sale of which is restricted by Limitation Order L-79.

This new form, which will be of mutual assistance to the purchaser, plumber and dealer, further simplifies the procedure so that applications will be handled in the Field Offices, which are more familiar with conditions in local areas.

The instructions indicate when the form should or should not be used. Form PD-851 should not be used to obtain plumbing and heating equipment for repair or replacement of existing equipment which is worn out, damaged or destroyed. Repair or replacement procedure should be handled by the material suppliers, who are assisted by Order P-84.

Form PD-851 should not be used to acquire any item which is rationed by OPA. The local rationing board should be consulted concerning rationed items.

When applying on Form PD-851, the ultimate consumer (occupant or owner) should file two copies with his nearest WPB Field Office and keep one copy for his own records.

The civilian was also considered at a meeting of members of the Plumbing and Heating Distributors Industry Advisory Committee and government officials late in April. Committee members urged the establishment of a preference rating sufficiently high to enable the distributor to obtain repair parts and complete replacement units from the manufacturer.

They also urged that certifications to obtain repair parts call for signature by the consumer only. This certification would be retained in the files of the person selling the repair part to the consumer.

The members also recommended that certification covering a complete replacement unit be strengthened and the order so written that this certification would be forwarded to the distributor, who would retain it in his file for possible inspection by the WPB Compliance Division. It was suggested that such certifications be signed by consumer and installer, and that complete replacement units for which this certification is necessary should be enumerated in a definite list which should be part of a formal WPB order.

APRIL WASHINGTON NEWS HIGHLIGHTS

Editor's Note: In addition to its monthly summary of Washington news, HEATING AND VENTILATING publishes a digest of the month's Orders, Amendments and press releases of particular interest to the industry. Complete copies of the releases or publications can be secured by writing U. S. Information Center, 1400 Pennsylvania Avenue, Washington, D. C., mentioning the date of the release and the reference number. The first figure in each listing is the date in April the release was issued.

28th — PETROLEUM PENALTIES STREAMLINED. Streamlining of action against those who violate orders, directives or regulations of the Petroleum Administration for War was announced today by PAW Administrator Ickes. OWI-1718.

27th — FUEL CONVERSION LOANS DEFERRED. FHA announces details of plan for delayed payment of loans which finance conservation installations. OWI-1665.

26th—REFRIGERATION PRICE LEVELS SET. Methods of pricing used refrigerating and air conditioning equipment of less than 25 horsepower, which is sold as part of WPB program to convert such equipment for use in war industries, were announced by OPA with issuance of amendment 162 to Supplementary Reg. 14, effective May 1. OPA-2339.

25th—CLAY HEATERS READY SOON. Ceramic space heaters and ceramic stoves may soon be available for American purchasers. WPB-3289.

24th — 469 MERCHANT SHIP CONTRACTS. Contracts for construction of 469 merchant ships, including 189 new design Victory ships and 206 high speed tankers, were announced today by U. S. Maritime Commission. Release names eight successful contractors. OWI-1675,

24th — VALVE ORDER MODIFIED. Limitation Order L-252, issued in January to reduce types of gate, globe, angle cross and check valves, has been revised to eliminate certain specifications of physical properties of some of steels contained in original order. WPB-3301.

17th—CONVERSION GRATES PRICED. Specific dollars-and-cents ceilings for recently developed grates to be used in converting rectangular heating plants from oil to coal were announced by OPA in Amendment 2 to Regulation 236, effective April 23. OPA-2282.

14th — REFRIGERATION ORDER MODIFIED. Amendment of General Limitation Order L-38, issued today, modifies restrictions on deliveries of refrigerating and air conditioning machinery and equipment covered by the order. WPB-3189.

13th — TESTS TO SEEK NEW COLLOIDAL COAL-OIL FUEL. Exhaustive tests to develop fuel composed of mixture of oil and coal, for years goal of research chemists and engineers, have been started by U. S. Bureau of Mines and the Atlantic Refining Co., in industrial boiler of the company at Philadelphia refinery. OWI-1628.

7th — Q. AND A. ON A-C EQUIPMENT ORDER. A question and answer discussion of Conservation Order L-38 (refrigerating and air conditioning equipment and water coolers as amended March 27, 1943, was issued today by WPB. WPB-3100.

6th — COPPER RESTRICTIONS AMENDED. Copper Order M-9-c was amended by WPB today and now prohibits use of copper in fans, except as permitted by Order L-176; and in air-conditioning and refrigerating equipment, except as permitted by Order L-126 and L-38.

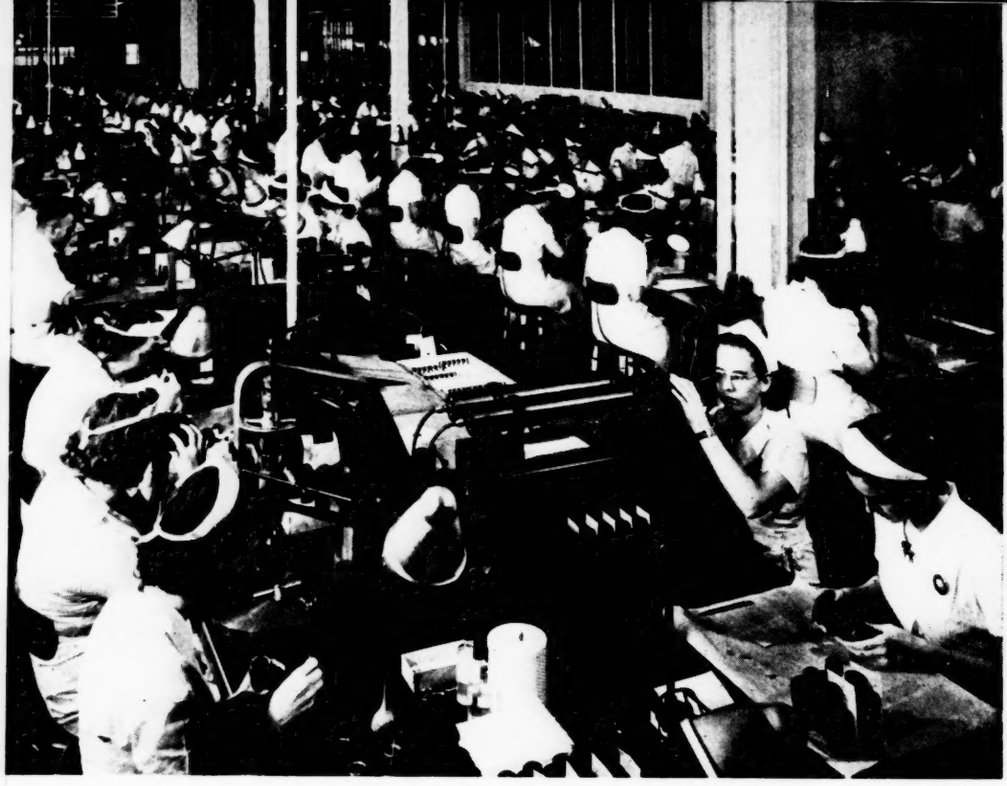


Fig. 1. Under perfectly controlled atmospheric conditions, both air conditioning and electric air cleaners protect these binoculars from dust, lint, and other air-borne dirt particles, during assembly of the delicate devices. Wearing freshly starched white uniforms the girls shun facial makeup because even a flake of powder on the sensitive lens would impair vision.

Spot Air Conditioning Speeds War

PROFITS IN AIR
HOW INDUSTRIAL PLANTS PROMOTE PROCESSES BY CONTROL OF AIR CONDITIONS

Air Conditioning's part in helping to win the war is not confined to the huge conditioned blackout plants; perhaps even more interesting are the numerous applications of small units to highly specialized and vital operations not even dreamed of a few years ago.

By L. W. CLIFFORD

Air Conditioning Dept., Westinghouse Electric & Mfg. Co., East Springfield, Mass.

WITH sleeves rolled up, air conditioning is increasingly an efficacious tool for speeding war production. Applications range from specialized use in aviation trainers and chilling shot, to broad industrial fields such as cooling welding-electrodes or conditioning metallurgical laboratories. The following typify and give some of the flavor of the present usefulness of spot air conditioning.

Trainer Buildings

As a part of the extensive program of training the thousands of student fliers in the various branches of our armed services, simulated flight training is very important. Many hours must, of course, be spent in the air in actual flight during the basic and advanced training periods. Likewise, each student flier must put in long hours on the ground in the study of mechanics, aerodynamics, navigation and the fundamental study of the instruments and controls that make controlled flight possible.

For these latter studies, particularly, many unique devices have been developed.

So that the study and use of the plane's controls and instruments might be conducted in complete safety on the ground the Link trainer has been developed. In this device the student pilot can actually go through the complete cycle of a flight from takeoff to landing without actually leaving the ground.

Likewise for the study of celestial navigation, special rooms are required where the celestial bodies and their position and movement can be studied and where in complete darkness, if desired, the student pilot makes synthetic flights, guided only by these same stars and planets.

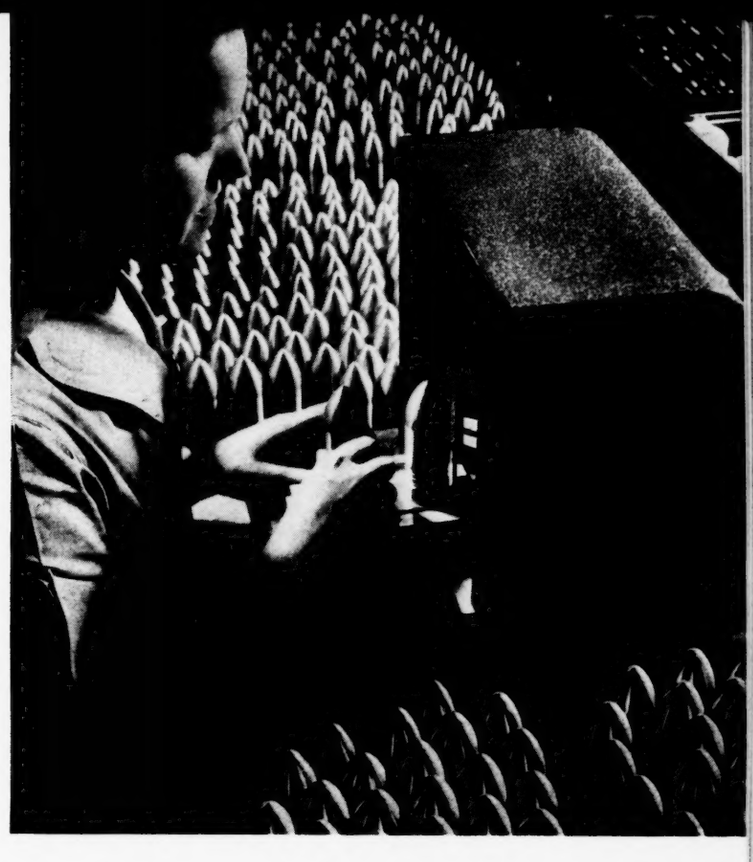


Fig. 2. War production requires air conditioning in many industrial processes for maximum output.

At air bases and flying fields throughout the country, buildings have been built and others are now under construction to house these Link trainers, either singly or in batteries, for this phase of their training or for the study and practice in celestial navigation.

Unless the Link trainer and celestial navigation buildings are air conditioned some serious problems arise. Some of the difficulties encountered when, without air conditioning, the room temperature and relative humidity values rise to extremely high levels include: (1) Instruments will not act consistently; (2) efficiency and reaction speed of the student are lessened; and (3) the hazard of perspiration damage to the controls and instruments is greatly increased.

Control Tower

At all air fields one of the principal nerve centers of field operations is the radio control tower. This is a large room, completely enclosed in glass from a height of 48 in. above the tower room floor to allow clear visibility in all directions.

Usually this tower is above one of the hangar buildings or else is supported on a structural framework at a height of about 50 ft above the ground. From this tower all plane traffic is controlled by means of radio communication. Permission to take-off and land must be obtained from the tower officer, as well as instructions as to runway to use for planes leaving or arriving. In bad weather the tower officer renders invaluable assistance to pilots having difficulty in locating the field and in landing.

Completely unprotected from the sun and with walls glassed in, the control towers develop very high internal temperatures, especially in the South. Regulations require that the door be kept locked at all times and the expensive and sensitive instruments and equipment make it impractical to use opened windows for ventilation.

As a result, air conditioning again provides the answer to the problems of making possible the continued efficiency of the human equation and consistent and reliable operation of the instruments and equipment in the control tower.

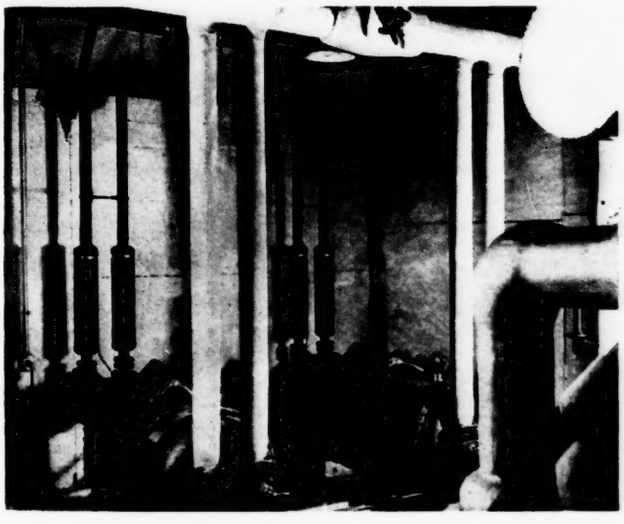


Fig. 3. Air conditioning compressors installed in basement of modern war industry building.

Metallurgic Spectrograph Rooms

In plants where metals are utilized in any appreciable quantity the laboratories are constantly testing metals as received from the supplier or as they are utilized for fabrication, so as to make sure that they meet specifications, particularly as to the required content of nickel, chromium, or other alloys.

A considerable length of time is required in making a normal chemical analysis of a metal sample to obtain both qualitative and quantitative test results. However, by means of an ingenious device called a spectrograph these analyses can be quickly made. Small electrodes are first molded from the metal to be analyzed. An electric arc is drawn between these

sample metal electrodes and a light beam from this arc is directed by lenses and prisms and focused on the sensitized film held in a frame in the spectrograph cabinet.

When the film or plate is developed, in the normal manner, the laboratory technician, from the location and intensity of the many spectrum lines on the plate, can read the complete analysis of the metal samples.

For this analysis to be accurate many factors must be carefully considered. The lenses and prisms must be free from dust, lint and marks from perspiring hands. The fine apertures through which the light beam passes must be, likewise, free from dust flecks. The relative humidity must be kept constant to assure consistent performance of the arc interrupter device. The emulsified plates or films must be stored under carefully controlled conditions of temperature and relative humidity to prevent their deterioration and subsequent poor results when they are used. Constant temperatures are important also in maintaining a fixed focus in the optical equipment. Again air conditioning provides the answer to all these problems.

Chilling for Shot Testing Tanks

In the production of armor-piercing solid shot careful inspection of each shot is a very important part of the manufacturing process. Ofttimes, when machining and heat treating processes are completed, stresses and strains, or even invisible cracks, are present in the shot and, if these are not found in inspection, the shot, when fired, may damage the gun or may break up in flight and be valueless.

An ingenious method of *shock testing* the shot to bring out these defects, has been devised. The process consists of a series of alternate immersions of the shot into chilled and hot tanks. The liquids in the two chilled tanks are maintained by means of automatically controlled mechanical refrigeration units.

In actual practice the series of insulated tanks is usually built into the production line and the wire baskets containing the shot progress through the alternate cold and hot tanks by conveyor or are manually carried. The immersion time in each tank is usually from 2 to 4 minutes.

Refrigeration of Welding Tips

Due to the magnitude of the wartime load thrown onto the industrial plants of this country and the continuous clamor for production speed-up, any development which makes for reduced maintenance or higher production rates receives much attention.

Such development is the practice of refrigerating spot welding electrode tips, to increase the number of welds it is possible to make between each cleaning of the welding tips. Particularly in the welding of aluminum has refrigeration of the tips shown remarkable results, and increases as high as 1000% in the number of welds per cleaning have been obtained.

The refrigeration of the electrode tips is accomplished by means of chilled water circulated through the specially constructed tip holder. The ideal water temperature seems to be rather controversial and some authorities even advocate the use of Prestone mixed with the circulated water to allow the temperatures to be brought below 32F. However, the frost accumulation and the consequent dripping water from the defrosting which results during shutdown are objectionable and one series of tests showed relatively small additional benefits to be derived from reducing liquid temperatures below freezing temperatures.

One proposed specification for welding aluminum states that the water temperature should be below 40F and must not be above 75F. Our evaluation of the recommendations of the various contributing authorities would lead us to believe that a water temperature of 40F will give very satisfactory results.

The equipment required is a condensing unit, together with a water chilling unit and the necessary valves and control equipment.

From available data it would appear that, for welders with ratings of 15 to 100 kva, condensing units ranging in size from ½ to 3 hp would be approximately of the required capacity.

Operating Rooms

For many years the concept of air conditioning in hospital operating rooms has been generally accepted. By supplying clean, filtered air the dangers of infection are greatly minimized. Humidity control is essential to minimize the hazard of explosions from static discharges in the anaesthetic-laden atmosphere and to maintain comfortable conditions for the surgeon and his assistants. Temperature control, likewise, contributes to the efficiency of the operating room personnel.

In these past several months, however, these needs have taken on an even greater significance as both industry and the armed services dip continually deeper into our reservoir of available man-power.

Both the magnitude and tempo of industrial production and military training have been stepped up to a point unheard of in our history. To allow this to continue, every available man-hour of productive effort and fighting strength must be carefully guarded against the staggering toll of lost time from those inevitable accidents which occur in increasing numbers as the size and speed of the program is increased to even higher levels.

This means that, in the treatment of the injured, there can be no compromise in the adequacy of the equipment and care with which such treatment is given, either in the industrial plant or in the service cantonment.

Pioneered by virtue of war necessity, spot air conditioning in these and similar fields promises increasing expansion throughout general industry.

DEGREE-DAYS FOR MARCH, 1943

HEATING AND VENTILATING'S 15th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days			Year[1]
	Degree-Days, Mar., 1943	Degree-Days, Mar., 1942	Degree-Days, Mar., Normal	Season, 9/1/42-3/31/43	Season, 9/1/41-3/31/42	Season, Normal 9/1-3/31	Normal, 9/1-6/30
Abilene, Texas	415	286	273	2270	2297	2034	2061
Albany, New York	1039	836	980	6350	5748	5848	6580
Albuquerque, New Mexico	519	672	527	3434	4082	3970	4298
Alpena, Michigan	1297	1050	1213	6934	6218	6873	8299*
Anaconda, Montana	1275	1080	1081	6812	7097	6737	8357**
Asheville, North Carolina	634	553	555	3722	3670	3831	4232
Atlanta, Georgia	470	410	388	2689	2776	2758	2890
Atlantic City, New Jersey	743	670	806	4120	3924	4437	5176
Augusta, Georgia	339	273	273	2056	2121	2137	2161
Baker, Oregon	886	880	880	5795	5980	5904	7163
Baltimore, Maryland	634	554	701	3909	3547	4163	4533
Billings, Montana	1221	908	955	6381	6145	6209	7119
Binghamton, New York	948	840	995	5848	5385	5960	6808
Birmingham, Alabama	415	332	260	2353	2483	2283	2352
Bismarck, North Dakota	1403	1040	1283	8451	6943	8152	9192
Block Island, Rhode Island	896	781	911	4920	4543	4678	5788
Boise, Idaho	780	770	651	4981	5357	4881	5552
Boston, Massachusetts	902	749	908	5264	4761	5230	6045
Bozeman, Montana	1287	1170	1096	6939	7492	6993	8521**
Buffalo, New York	1076	893	1032	6022	5452	5800	6822
Burlington, Vermont	1163	916	1088	7010	6490	6584	7514
Butte, Montana	1337	1180	1048	7425	7853	6683	8272
Cairo, Illinois	656	454	539	3624	3503	3708	3909
Canton, New York	1185	952	1160	7237	6704	7002	8020
Charles City, Iowa	1237	892	1024	7234	6018	6752	7588
Charleston, South Carolina	315	229	242	1802	1769	1733	1769
Charlotte, North Carolina	477	368	428	2850	2744	2961	3120
Chattanooga, Tennessee	507	465	415	3063	3321	2974	3118
Cheyenne, Wyoming	1136	1023	995	5942	6334	6174	7466
Chicago, Illinois	1019	787	902	5965	4944	5178	5957
Cincinnati, Ohio	783	599	676	4542	4158	4351	4684
Cleveland, Ohio	883	775	930	5200	4803	5371	6155
Columbia, Missouri	808	609	694	4616	4165	4597	4922
Columbia, South Carolina	367	291	301	2230	2214	2301	2364
Columbus, Ohio	833	661	778	4851	4449	4891	5398
Concord, New Hampshire	1110	872	1011	6674	6118	6332	7353
Concordia, Kansas	872	697	735	5040	4681	4908	5315
Dallas, Texas	440	287	267	2265	2309	2247	2256
Davenport, Iowa	973	753	893	5921	5046	5718	6289
Dayton, Ohio	846	661	744	4837	4466	4787	5264
Denver, Colorado	884	833	800	4604	5237	5073	5874
Des Moines, Iowa	1022	796	890	6011	5252	5825	6384
Detroit, Michigan	967	820	973	5836	5182	5691	6490
Devils Lake, North Dakota	1522	1112	1323	9127	7657	8694	9970
Dodge City, Kansas	831	627	688	4476	4362	4646	5035
Dubuque, Iowa	1071	790	958	6444	5365	6152	6790
Duluth, Minnesota	1454	1041	1265	8359	7068	7945	9443
Eastport, Maine	1136	926	1110	6675	6275	6612	8520**
Elkins, West Virginia	825	704	763	4833	4762	5019	5697
El Paso, Texas	289	337	282	2146	2292	2383	2428
Ely, Nevada	497	1066	(a)	5588	6686	(a)	(a)
Erie, Pennsylvania	931	854	973	5414	4990	5407	6273
Escanaba, Michigan	1367	1067	1262	7426	6447	7290	8771*
Evansville, Indiana	773	559	620	4369	4064	3968	4244
Fort Smith, Arkansas	557	381	397	2974	2999	3054	3147
Fort Wayne, Indiana	976	810	818	5849	5248	5321	5925
Fort Worth, Texas	446	287	217	2267	2298	2121	2148
Fresno, California	267	328	316	2291	2279	2199	2334
Galveston, Texas	203	194	78	1039	1294	1016	1016
Grand Junction, Colorado	690	801	672	4400	5115	5046	5548
Grand Rapids, Michigan	1034	839	964	5927	5224	5827	6535
Green Bay, Wisconsin	1260	937	1125	7139	6032	6903	7825
Greensboro, North Carolina	585	489	474	3514	3452	3319	3529
Greenville, South Carolina	503	431	446	2897	2843	3185	3380
Harrisburg, Pennsylvania	754	694	803	4741	4469	4880	5357
Hartford, Connecticut	935	755	887	5575	5109	5303	6036
Hatteras, North Carolina	443	318	465	2277	2215	2316	2571
Havre, Montana	1302	999	1169	7551	6715	7557	8700
Helena, Montana	1363	1007	1004	7420	7379	6615	7898
Houston, Texas	212	178	65	1196	1378	1157	1157
Huron, South Dakota	1229	963	1092	7497	6177	7167	8004
Indianapolis, Indiana	906	651	756	5100	4389	4855	5298
Ithaca, New York	963	863	1020	5877	5487	5871	6719
Kansas City, Missouri	819	624	691	4657	4149	4644	4956
Kewanee, Illinois	1059	639	795	6229	4710	5131	6139
Knoxville, Tennessee	586	465	496	3396	3318	3460	3670
La Crosse, Wisconsin	1256	847	1033	7169	5796	6611	7322
Lander, Wyoming	1219	1056	1028	6569	7387	6694	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table Concluded on Page 82]

Degree-Days for March, 1943 (Concluded)

HEATING AND VENTILATING'S 15th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days			Year[1]
	Degree-Days, Mar., 1943	Degree-Days, Mar., 1942	Degree-Days, Mar., Normal	Season, 9/1/42-3/31/43	Season, 9/1/41-3/31/42	Season, Normal 9/1-3/31	Normal, 9/1-6/30
Lansing, Michigan	1063	878	1035	6329	5572	6237	7048
Lewiston, Maine	1137	906	1093	6784	6327	6625	7707
Lincoln, Nebraska	949	766	840	5531	5058	5483	5999
Little Rock, Arkansas	554	349	353	2918	2868	2733	2811
Livingston, Montana	1140	998	967	6223	6416	5985	7205
Los Angeles, California	194	192	239	951	1062	1255	1504
Louisville, Kentucky	707	515	589	4087	3777	3916	4180
Lynchburg, Virginia	577	478	564	3520	3342	3707	3980
Macon, Georgia	350	323	260	2116	2292	2168	2201
Madison, Wisconsin	1163	876	1054	6864	5793	6611	7429
Marquette, Michigan	1346	1050	1249	7335	6413	7164	8693*
Memphis, Tennessee	567	364	384	2996	3114	2854	2950
Meridian, Mississippi	350	299	245	2092	2358	2136	2160
Milwaukee, Wisconsin	1116	885	1023	6598	5740	6208	7245
Minneapolis, Minnesota	1286	903	1094	7608	6157	7044	7850
Modena, Utah	763	886	827	5103	5927	5591	6562
Montgomery, Alabama	314	288	208	1846	2095	1884	1884
Nantucket, Massachusetts	883	786	899	4904	4571	4811	5957
Nashville, Tennessee	610	429	477	3370	3257	3327	3507
New Haven, Connecticut	859	734	899	5108	4660	5129	5895
New Orleans, Louisiana	210	166	59	1184	1323	1024	1024
New York, New York	791	680	837	4557	4261	4706	5347
Nome, Alaska‡	1568	1339	1660	9134	7318	8886	14580**
Norfolk, Virginia	505	433	521	2849	2797	3104	3350
Northfield, Vermont	1210	978	1203	7357	6816	7381	8719*
North Head, Washington	621	609	623	3644	3418	3755	5452**
North Platte, Nebraska	1004	841	875	5428	5487	5681	6366
Oakland, California	320	366	363	2261	2200	2392	3143**
Oklahoma City, Oklahoma	627	437	465	3361	3199	3451	3613
Omaha, Nebraska	985	813	868	5775	5306	5633	6131
Oswego, New York	1044	888	1060	6065	5603	5993	7088
Parkersburg, West Virginia	746	607	670	4370	4174	4371	4775
Peoria, Illinois	923	721	862	5621	4862	5535	6109
Philadelphia, Pennsylvania	699	628	756	4278	3961	4385	4855
Phoenix, Arizona	77	197	152	972	1352	1405	1405
Pittsburgh, Pennsylvania	776	678	787	4635	4358	4734	5235
Pocatello, Idaho	923	1027	843	5603	6704	5696	6655
Portland, Maine	1098	898	1017	6605	6068	6105	7218
Portland, Oregon	555	528	558	3498	3503	3732	4469
Providence, Rhode Island	862	718	890	5123	4735	5206	6015
Pueblo, Colorado	865	791	732	4652	5196	4872	5514
Raleigh, North Carolina	476	389	446	2943	2860	3051	3234
Rapid City, South Dakota	1229	902	1010	6508	5777	6150	7118
Reading, Pennsylvania	743	667	794	4663	4346	4876	5389
Redding, California	328	371	344	2275	2447	2295	2451
Reno, Nevada	656	748	753	4435	4894	4902	5892
Richmond, Virginia	548	490	543	3404	3329	3449	3695
Rochester, New York	1025	913	1029	6060	5627	5854	6732
Roseburg, Oregon	494	554	546	3212	3373	3636	4428
Roswell, New Mexico	439	497	428	2810	3259	3304	3484
Sacramento, California	303	353	357	2259	2275	2393	2653
St. Joseph, Missouri	873	697	682	5026	4566	4803	5161
St. Louis, Missouri	761	558	657	4271	3873	4309	4585
Salt Lake City, Utah	770	907	722	4912	5519	4866	5555
San Antonio, Texas	243	167	74	1402	1484	1202	1202
San Diego, California	158	221	251	961	1052	1350	1645
Sandusky, Ohio	905	779	915	5367	4835	5299	6208
San Francisco, California	290	305	353	1940	1852	2123	3264**
Sault Ste. Marie, Michigan	1498	1142	1314	6472	7204	7629	9285**
Savannah, Georgia	242	186	167	1476	1505	1490	1490
Scranton, Pennsylvania	893	771	893	5491	5078	5445	6129
Seattle, Washington	602	566	620	3668	3475	3917	4934**
Sheridan, Wyoming	1284	960	1048	6451	6467	6837	8008
Shreveport, Louisiana	374	272	202	2056	2233	1938	1938
Sioux City, Iowa	1078	871	967	6537	5800	6245	6898
Spokane, Washington	904	601	778	5617	4777	5485	6355
Springfield, Illinois	838	638	760	4983	4385	4951	5373
Springfield, Missouri	817	599	626	4276	4123	4149	4428
Syracuse, New York	1023	859	1004	6148	5607	5984	6893
Tacoma, Washington	643	600	648	3930	3791	4086	5181**
Terre Haute, Indiana	817	616	663	4761	4263	4539	4872
Toledo, Ohio	973	813	905	5700	5065	5372	6077
Topeka, Kansas	824	641	682	4679	4253	4635	4969
Trenton, New Jersey	763	673	735	4639	4315	4450	4933
Utica, New York	1079	919	989	6378	5919	5955	6796
Valentine, Nebraska	1181	970	980	6390	5948	6205	7039
Walla Walla, Washington	664	557	598	4386	4423	4274	4808
Washington, D. C.	610	545	694	3889	3648	4253	4626
Wichita, Kansas	812	600	648	4466	4128	4421	4673
Williston, North Dakota	1451	1075	1280	8448	7072	8238	9323
Winnemucca, Nevada	710	828	767	4757	5433	5411	6427**
Yakima, Washington	715	637	620	5104	4821	5053	5599

‡Nome data are for February.

*Includes August. **Includes July and August.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

How to Design Exhaust Hoods

By J. M. DALLA VALLE

Engineer and Consultant, Kruse Engineering Co., Newark, N. J.

Part 3—Velocity Contours of Hoods with Special Boundary Conditions

THE method of compounding velocity contours can be adapted so that the resultant contours hold for openings with special boundaries. Hoods are rarely used without some form of obstruction, being bounded either by extended planes or devices placed close to the plane of the opening. Consequently, if contours for special conditions can be developed from those known for simple openings, information of much practical value may be gained. Four special cases are discussed in the following, which indicate the general procedure for developing contours for any shape of hood under similar conditions. The method, while approximate, nevertheless gives results which are surprisingly accurate, as indicated previously.

Hoods with special plane boundaries offer the least difficulty. The procedure is based on the principle that a solid boundary may be substituted for any free stream surface or for any stream plane of symmetry. In this respect, the problem is analogous to the method of images used in capacitance calculations in electrical theory. In fact, the boundary cases discussed in the following are distinctly "image" problems.*

Case I—Infinite plane perpendicular to axis of hood at a given distance from the opening: In this

*See, for example, Jeans, J. H.: The mathematical theory of electricity and magnetism. Fourth edition, Cambridge University Press, 1923, Chapter VIII.

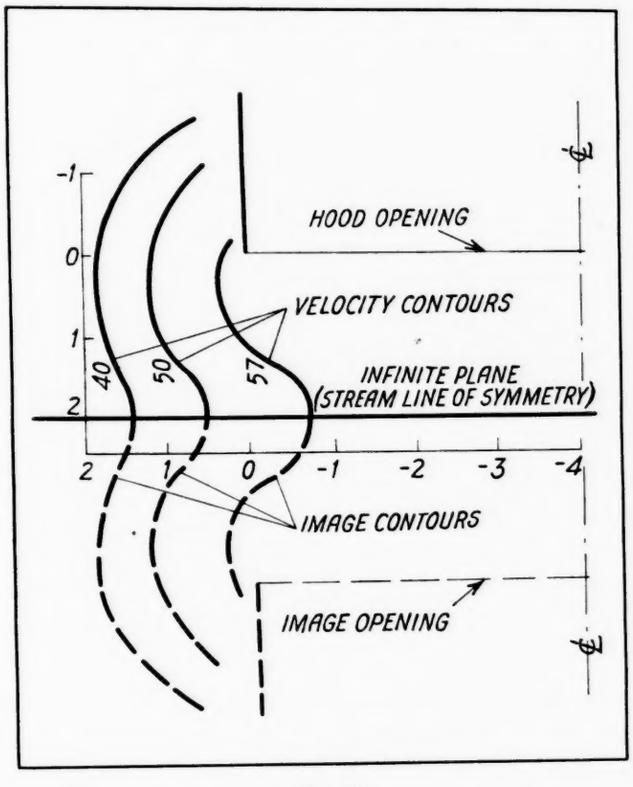


Fig. 25

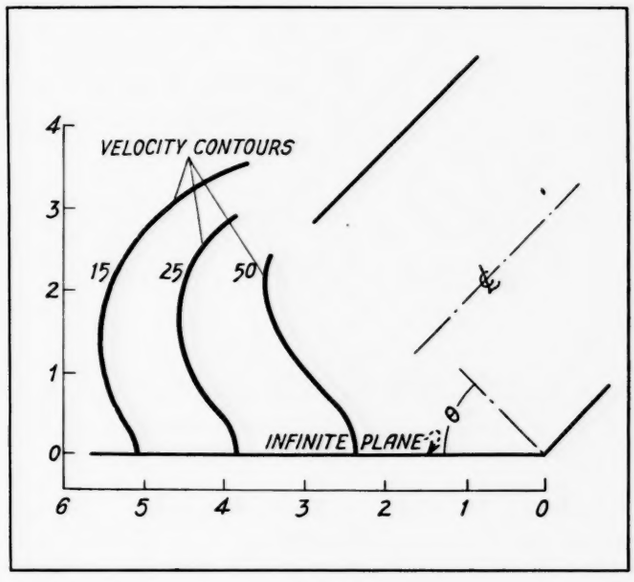


Fig. 26

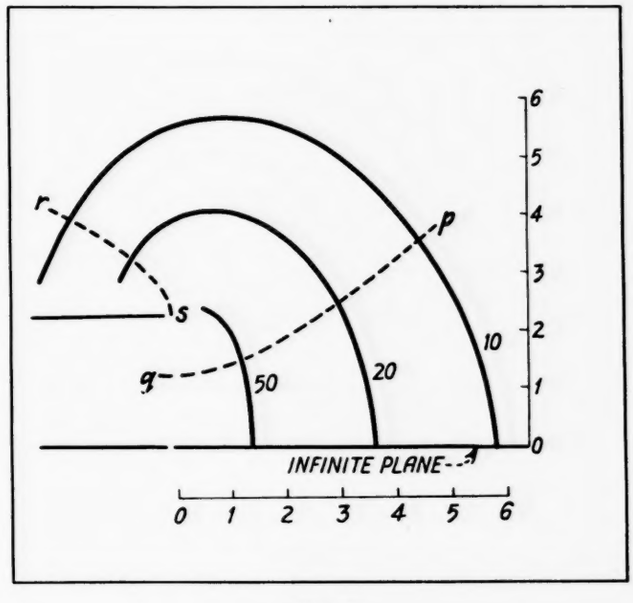


Fig. 27

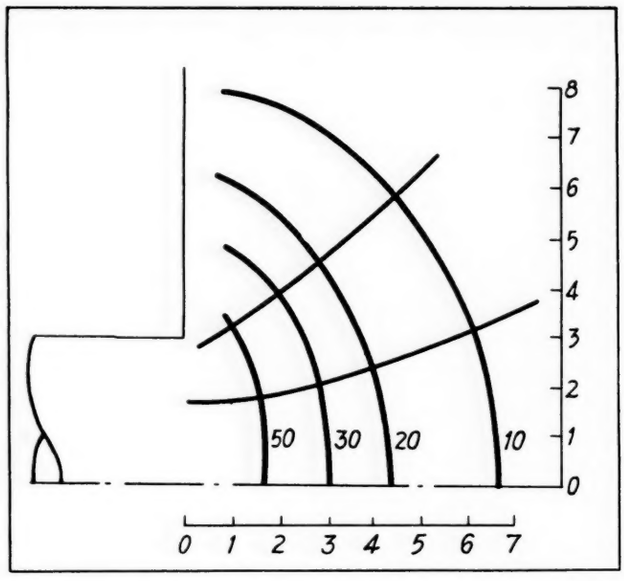


Fig. 28

case, the plane is established in the manner shown in Fig. 25. The velocity characteristics of two square openings lying along the same axis (at a distance equal to one-half the length of one of the sides) have been combined in the manner described, and the velocity distribution traced. Since no flow can take place across the stream plane of symmetry, this plane may be replaced by a solid boundary. Consequently, the hood drawn in broken lines may be removed without altering the flow into the hood. (The hood and contours removed may be regarded as images.)

Similar contours are obtained for hoods located above an infinite plane so long as their relative shapes and distances above the plane remain the same. In the particular case shown in Fig. 25, the infinite plane is located at a distance equal to one-fourth the length of one of the hood edges. Thus, for an opening 4 feet square, the distance is 1 foot. At other distances, new contours must be formed.

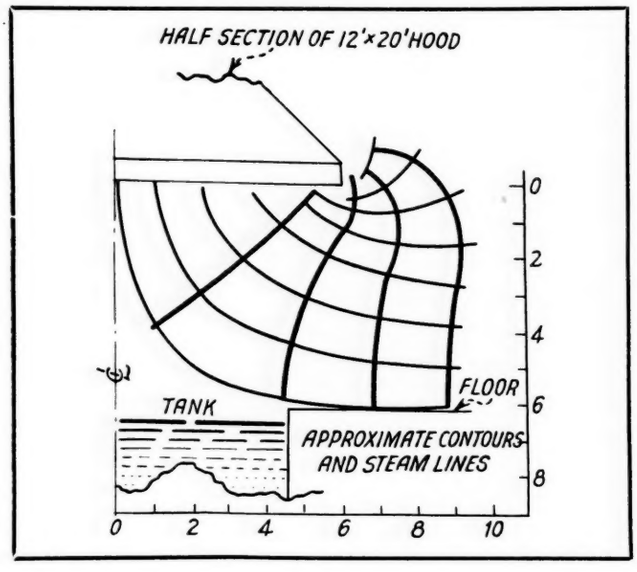


Fig. 30

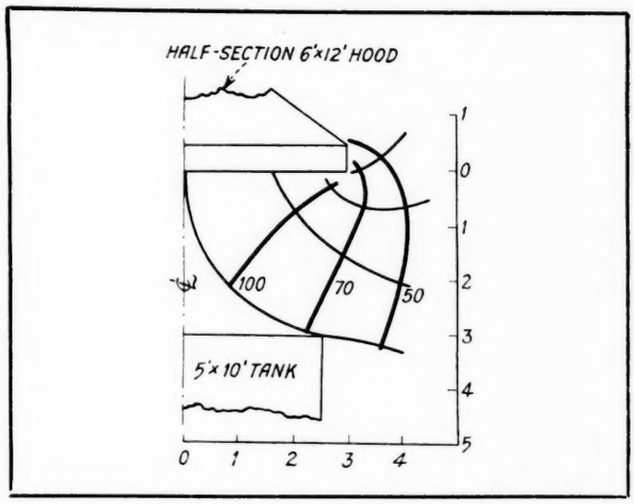


Fig. 29

Case II — Infinite plane at a given angle to the plane of the hood opening: This condition is encountered in practice when a hood is placed at an angle to a large surface. An extreme case is given in Fig. 26 where the edge of a square hood is shown touching a plane at an angle of 45°. The resultant contours are developed from the distributions of two square openings tilted at 90° to each other with corresponding edges touching. As in the previous case, since no flow takes place across the stream plane of symmetry, a solid boundary may be inserted without altering the conditions of flow. The removal of the "image-hood" does not change the velocity characteristics of the other. The method may be duplicated for hoods at almost any angle to a plane (ex-

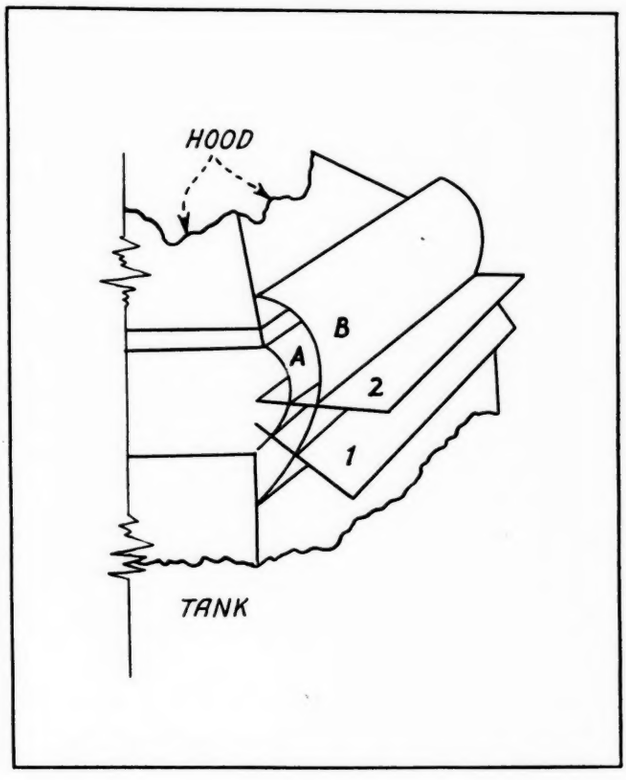


Fig. 31

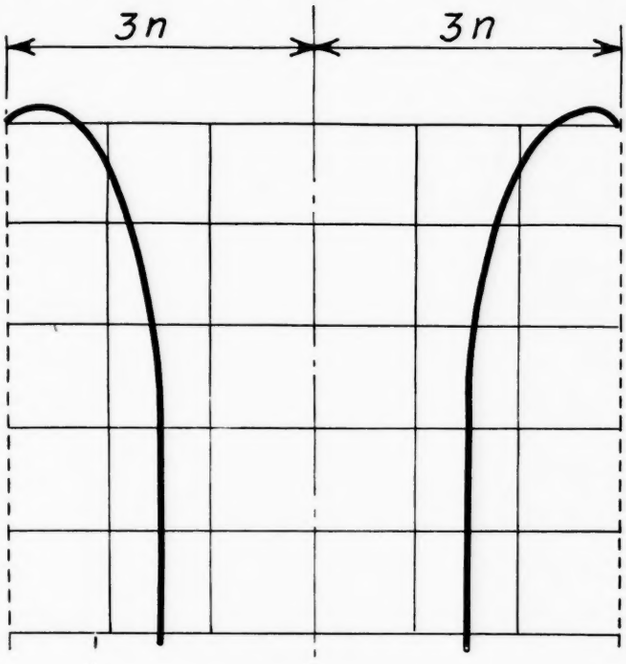


Fig. 32

cept small angles) and for conditions where the edge of the hood does not touch the plane.

For the case given in Fig. 26, one may draw conclusions similar to those given for the previous case, namely, that the contours are the same for any square hood at an angle of 45° to an infinite plane, one of whose edges meets the plane. The length of the hood edge may be used to determine the relative locations of the contours.

Case III—Infinite plane parallel to the axis of a hood and touching one of its edges: Since the flow in an upper quadrant of a symmetrical hood is the same as that of the lower, it follows that both halves may be separated by a solid boundary without affecting the contour distribution in either. This implies, for example, that the contours for a square opening drawn in a quadrant plane may represent the velocity distribution of an opening with a ratio of sides equal to one-half with an infinite plane attached to the longer side and parallel to the hood axis.

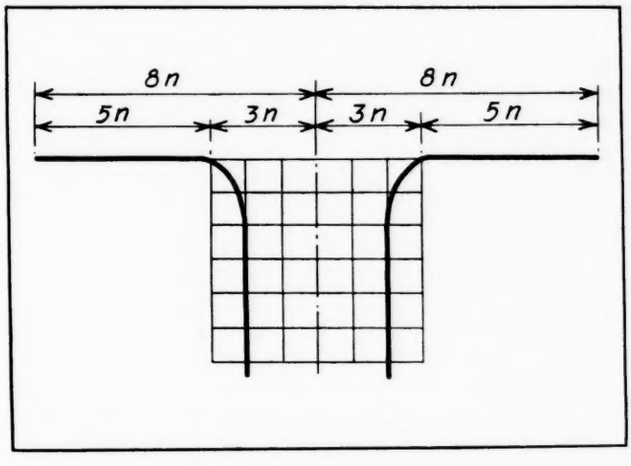


Fig. 33

Hoods included in Case III have a very practical application, especially in exhausting fumes from tanks through lateral openings and dust generated by granite-cutting machines. Fig. 27 shows the velocity distribution obtained in a quadrant plane perpendicular to the long edges of a rectangular opening with a side ratio equal to one-half. However, since we are concerned with the distribution of contours above an infinite plane as shown in the figure, the opening must be regarded as having a side ratio equal to one-fourth.

Case IV—Hood with infinite plane surrounding it and having a plane coinciding with its axis: This case is a combination of the simple flanged hood and Case III and is represented for a circular opening in Fig. 28. However, this case has only a practical application and need not be discussed in detail.

Method of Estimating Contours

From numerous studies on velocity distribution of hoods under suction it has been shown that the stream lines immediately behind the plane of the opening originate from the edges of the hood. These lines are only slightly altered by any obstruction forward of the opening itself, even though the obstruction be quite large. Therefore, whatever distortion takes place in the distribution of the stream lines will in most instances conform to the contour of the obstruction itself. Hence, in Figs. 29 and 30, which represent sections of hoods placed over a plating tank and a pickling tank, respectively, the stream lines in a center plane may be traced so that they conform closely to the boundary conditions. When the stream lines have been established, any continuous curve cutting them perpendicularly will be a contour of equal velocity. The actual conditions which occur are illustrated in Fig. 31, which shows two contour surfaces (A and B) intersected by two planes of flow (1 and 2) for a hood such as used over a steam tank. The corner effects are not indi-

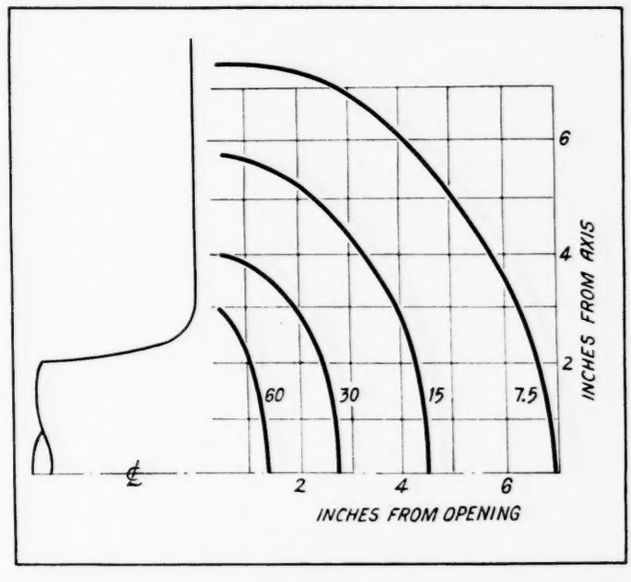


Fig. 34

cated, but it can be shown that if the distribution of flow over an opening is uniform they are not very important.

An estimate of the extent of the zone of influence for many openings can be made by imagining these openings enveloped by spheres. Approximate values of the air velocity passing the spherical boundary can be obtained by means of Equation 1.

Formula for Tank Hood Air Flow

A correlation of data obtained by the methods above outlined shows that for large vertical hoods used to collect fumes from chemical vats and tanks, the air velocity about their edges is accurately deduced from the formula

$$Q = 1.4\ PDV \qquad (25)$$

where Q is the volume of air flow into the hood, P is the perimeter of the vat or tank, and D is the vertical distance from the hood opening to the region where the fumes were given off, all units being consistent.

Velocity Contours of Shaped Openings

The contour of a shaped opening coincides with the free stream surface of a fluid entering it. The revolution of the curves generated by these equations about the axis of the opening gives the contour in question. Openings generated by the free stream lines of simple or flanged duct ends eliminate the abrupt entrance of the fluid and the vortex produced peripherally, discussed in other parts of this paper. It is obvious that the motion of a fluid directed so as to eliminate eddying will have many advantages over other types, due to reduction of the entrance losses. Fig. 32 shows the free stream lines calculated from these equations for an opening 6 inches in diameter.

In the case of a shaped opening with a flange, given by Equations 8a and 8b, the opening conforming to these equations when the edge diameter is 6 inches, is as shown in Fig. 33. Such an opening spun as in Fig. 33 was found to have velocity characteristics identical to those shown in Fig. 13. (Compare with Fig. 34.)

Velocity Contours for a Narrow Slot

The actual velocities for a slot with a ratio of sides 0.1 or less is given to a fair degree of accuracy by an equation similar to Equation 3, that is

$$\frac{Y}{100 - Y} = 0.2 w^{2.10} x^{-1.91} \qquad (26)$$

where w is taken as the width of the slot. The values obtained by this equation agree well with those calculated by means of Equation 4 for values $r \leqq 0.1$.

(Next month's installment will discuss criteria for determining hood effectiveness.)

Unit Heater Maintenance

Unit heater upkeep is becoming increasingly important to factory maintenance departments. The problem of parts replacement is more worrisome than ever; the use of non-critical substitutes has raised the possibility of new types of servicing and at more frequent intervals; unfamiliarity with equipment due to changes in personnel, also a shortage of skilled mechanics for the work, may result in a lower standard of service given; finally, the added hours of heater operation and the difficulty of reaching the equipment during round-the-clock plant operation when cranes, trucks, and running machinery must be contended with, all combine to create a sizable headache for the maintenance superintendent.

A new unit heater maintenance chart by the Modine Manufacturing Co., Racine, Wis., summarizes the critical points of heater upkeep and makes recommendations regarding care of the vital parts. Inspection every four months is urged, and oftener than this where special conditions exist, such as contamination from corrosive fumes, lint, dust, soot or oil spray. Motors should be dismantled at least once every three years and cleaned thoroughly inside and out.

These and many other points are covered on the chart, which is available on request to Modine.

Compressed Air for Coal Mine Ventilation

Definite economy in ventilation costs, by freeing coal mines of dangerous gas before a seam is worked, is being accomplished by sinking pipes into the ground ahead of the workings and pumping the gas out, according to the Compressed Air Institute.

This is being practiced at a mining operation near Bluefield, W. Va., where holes for the pipes are drilled to depths ranging from 100 to 1,000 feet, depending upon the thickness of the overburden between the coal and the surface. The pipes are sent a short distance through the collar of the holes and then connected to blowers which exhaust the gas.

Some of the mines where this is being done are extremely gassy, the Institute reports. One liberates as much as 12,000,000 cu ft of gas a day.

Although the amount of inflammable methane must be kept to a maximum of 0.5% in the mine atmosphere, it is the aim of this new gas-evacuating process to reduce the amount of methane in the mine atmosphere 50% before a coal seam is opened.

NEWS OF THE MONTH

New Section Formed by Stoker Group

CHICAGO—The organization of an Anthracite Section in the Stoker Manufacturers' Association was officially completed at a meeting of anthracite st ker manufacturers in New York City in mid-April.

Executives in attendance at the meeting represented practically all manufacturers of hard co.l burners, and elected Milton A. Young, Catskill, N. Y., as chairman of the Anthracite Section. Mr. Young is sales manager of the Catskill Metal Works, Inc.

Three standing committees were named to handle problems and subjects dealing with anthracite stoker equipment. Frederick Kalmbach, president, General Machine Co., Emmaus, Pa., was appointed chairman of a development committee; Harold A. Cooper, Cooper & Cooper, Inc., Pittsfield, Mass., will act as chairman of the trade relations committee; and Adair Rogers, president, Stewart-Rogers, Inc., Philadelphia, was named as chairman of the engineering committee.

Birthday for Industrial Builder

NEW YORK—Private industry's record in war production is a fair indication of the capability of business and industry to solve post-war problems for themselves and for the Nation, Harold K. Ferguson, president of The H. K. Ferguson Company, industrial engineers and builders of Cleveland and New York, said April 29 in a message commemorating the 25th anniversary of the founding of his company. The Ferguson Company was founded in 1918, and was one of the first organizations in the United States to offer "a complete industrial service," consisting of designing, building and equipping plants and factories ready for operation by their owner.

Addressing his own employees and associates, Mr. Ferguson complimented them for "record after record you have continually achieved since we in The Ferguson Company went to war in December, 1940, a full year ahead of Pearl Harbor."

"Only through your efforts—not mine, certainly—were we able to finish our first big war job, a shell loading plant and ordnance depot in Tennessee two and three months ahead of schedule, respectively," he said. Since then, he added, his company has participated in scores of other war jobs, some large and some small, but all important. He said that most often we praise only those who design and construct the multi-million dollar installations, but that he could never overlook the results of those in his organization who were as.igned to building small plants and making unspectacular plant conversions and factory additions.

Buensod-Stacey Changes Name

NEW YORK—At a meeting of the stockholders of the Buensod-Stacey Air Conditioning, Inc., held April 7, it was voted to change the corporate name to Buensod-Stacey, Inc.

Navy Honors Kahn Office

DETROIT—An unusual honor has been paid the firm of Albert Kahn Associated Architects and Engineers, Inc., for its work in designing buildings and facilities for numerous Naval bases. This is in the form of a special, hand-engrossed certificate of commendation from Rear Admiral B. Moreell, Chief of the Bureau of Yards and Docks, The Navy Department, which reads:

"The Bureau of Yards and Docks, Navy Department, commends Albert Kahn, Incorporated, for outstanding services rendered—Their devotion and unswerving fidelity to the tasks in hand when designing buildings and facilities for Naval Air Stations and for other Naval Stations on numerous Pacific Islands, Alaska and Continental United States in furtherance of The Navy War Construction Program."

Oil Men to Fight More Conversions

BOSTON—Opening guns in a battle that may assume nation-wide proportions, against forced conversions of domestic oil burners to coal, said to be pending, were fired recently at a dinner mass meeting of oil men, oil burner men, accessory dealers and many interested consumers, who gathered at the Hotel Statler from all parts of New England. Nearly a thousand persons were in attendance, to listen to Mayor Tobin of Boston, Lieut.-Gov. Cahill of Massachusetts, Congressman George J. Bates, and Fulton Lewis, Jr., radio commentator.

Furnace Men to Consider Post-War Market

CLEVELAND—The mid-year convention of the National Warm Air Heating and Air Conditioning Association will be held May 26 at the Drake Hotel here. President H. S. Sharp of the Association announces that Paul B. Zimmerman, chairman of the publicity and merchandising committee will have a message of unusual importance for the convention. He will present an outline of a post-war market development program.

Other timely and important subjects will be presented by F. G. Sedgwick, chairman, research advisory committee, and Professors A. P. Kratz and S. Konzo of the University of Illinois.

"Outside" Controls Advocated

WASHINGTON—The Office of Price Administration has published a four page 8 x 11 in. folder, the center pages of which can be used as a single poster. The purpose of the folder is to call attention to several methods of conserving fuel in multiple occupancy buildings, including insulation, thermostats, and outside thermostatic control. The folder emphasizes that outside controls are available without priority.

The folder is being sent to all fuel rationing boards.

—67F Air, 8000 Tons of A.C. for Stratosphere Tunnel

YORK, PA.—Six hundred mile per hour wind velocities at —67F soon will test the endurance of Uncle Sam's stratosphere bombers and fighters before they leave the ground in the Army's newest and most powerful wind tunnel.

The new tunnel, to be built at the Wright Field, Ohio, proving ground, will be refrigerated to stratosphere conditions by an air conditioning plant now being assembled by York Ice Machinery Corporation engineers. This equipment will cool four million cubic feet of air per minute.

Traveling in a partial vacuum at six times the speed of a hurricane, the sub-zero stream of air in the tunnel will test the actual performance of plane parts and scale models under the same low temperature and air pressure encountered in aerial battles eight miles above the earth. The air blasts will strike the planes with enough force to shatter a solid brick wall, according to J. G. Bergdoll, Jr., chief engineer of York.

A 40,000 hp. motor, world's largest motor of its kind, will whip up the manufactured gales in a tunnel 600 feet long and built in the shape of a huge O. As the wind travels around the first turn in the tunnel it will pass over a network of cooling coils chilled by 8,000 tons of refrigeration. To simulate altitudes 40,000 feet and above, the temperature at the cooling coils will be —7F. It will drop to —67F by the time the air stream reaches the throat.

In making a stratosphere test, engineers will place models of aircraft parts in the steel test compartment of the tunnel's throat and close an airtight door. Decompression pumps will then evacuate the air until the pressure is reduced from a normal atmosphere to less than the 2.7 lb per sq in. found at altitudes above 40,000 feet. Through observation portholes in the throat, the engineers will be able to watch the effect; a control tower and an enlarged testing room will be built around the throat.

More than 85,000 cfm of filtered air will be required to cool the giant motor which will drive two 40-foot fans, each with 16 blades. The fans, each as tall as a four story building, will have a driving force of 200 tons per blade as they push the air stream toward the cooling coils. The conditioned air which pours from the throat of the tunnel would normally supply 600 small theatres. Blades are constructed of wood so they will remain flexible under the low temperature operating conditions. In addition to the building to be constructed around the throat of the tunnel, a second building will be erected to house the motor and fan. Tons of calcium chloride brine solution will have to be cooled and stored up in tanks over a period of 20 hours, to prepare the tunnel for each test, the engineer said.

The new Wright Field test tunnel will be located adjacent to the one completed at the field last year. This one, now in operation, has a maximum wind velocity of about 400 miles per hour and is not refrigerated. A larger throat opening, however, enables it to test larger equipment and its motor and fans are of the same horsepower as the new tunnel.

Low Temperature Work to be Featured by ASRE

NEW YORK—Low temperature application of refrigeration will be emphasized at the 30th spring meeting of the American Society of Refrigerating Engineers to be held June 1-3 at the Hotel Statler in Cleveland:

Among the papers to be presented at the meeting are:

"Low Temperatures by means of Multi-Stage and Other Compression Systems", by Harry Sloan, advisory engineer, Vilter Mfg. Co., Milwaukee.

"Insulation for Low Temperatures" by John F. Stone, Johns-Manville Corporation, New York.

"Refrigeration and the War Production Board" by Sterling F. Smith, Refrigeration and Air Conditioning Section, WPB, Washington.

"Industrial Low Temperature Cabinets" by R. H. Swart, Kold-Hold Mfg. Co., Lansing, Mich.

"Refrigeration of Electrodes in Welding" by Walter G. Moehlenpah, Frostrode Division, Weltronic Corporation, Detroit.

"Refrigeration Activity through the WPB Advisory Committee" by Marshall G. Munee, special assistant to the president, York Ice Machinery Corporation, York, Pa.

In addition, on the afternoon of June 1, there will be a Corrosion Conference presided over by Clifford F. Holske, sales manager, The Vilter Manufacturing Company, New York, and including discussions on various phases of corrosion in refrigeration, by W. Z. Friend, Robert B. Mears, V. V. Kendall, G. W. Seagren, and R. H. Brown.

Teaches Use of Controls

BALTIMORE—Automatic control of industrial processes is such an important factor in the war production program that Johns Hopkins University has established a special course to train technicians in the use of industrial instruments and controls.

The Brown Instrument division of the Minneapolis-Honeywell Regulator Company is cooperating in the educational program by assigning as guest lecturers, members of its Philadelphia technical staff. They will explain the working of such instruments as the recently developed electronic potentiometer, the Radiamatic pyrometer and air-operated process controls.

Sixty picked men from war plants in this area are attending the classes, which are under the direction of Dr. R. B. Anderson and which include both lectures and laboratory instruction in the principles of temperature measurement and use and maintenance of control instruments.

Fred W. Balderson

PHILADELPHIA — Fred W. Balderson, 32, office manager of the local branch of the Minneapolis-Honeywell Regulator Company, died February 20 after an illness of three months. He had been with the company for 12 years and is survived by his widow and infant daughter.

NO. 5 OF A SERIES

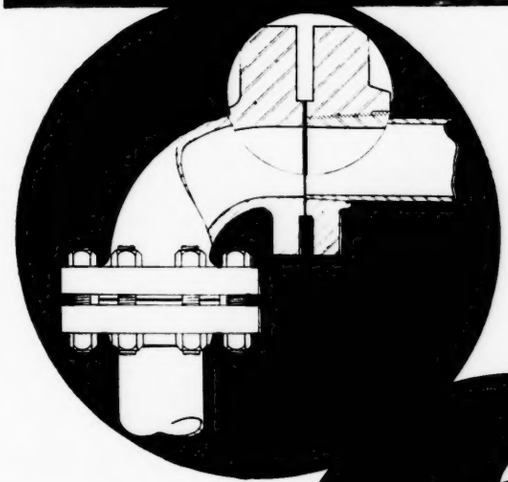
HOW TUBE-TURN WELDING FITTINGS BENEFIT WAR INDUSTRY

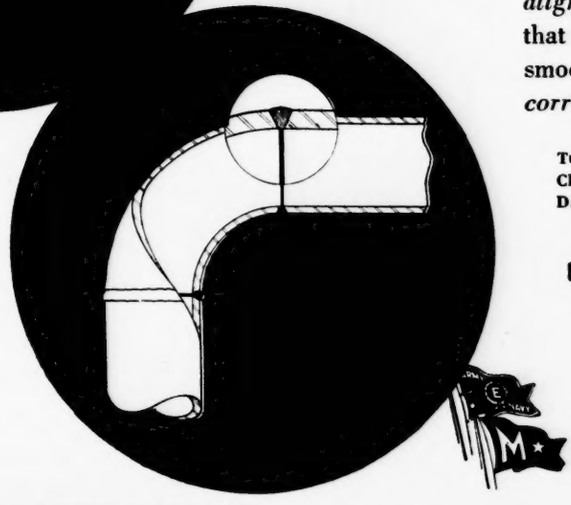
The FIRST WELDING FITTINGS 1ST AND STILL THE BEST

STOP

war production delays due to leaks and other avoidable piping troubles

WELD WITH TUBE-TURN WELDING FITTINGS





Contrast these diagrammatic drawings and enlarged cross-sections of a flanged ell (*above*) and a Tube-Turn 90° welding elbow (*below*) in a line. Note how the *welded* connection forms virtually a continuous tube without joints. Welding with Tube-Turn fittings *eliminates* the many maintenance headaches inherent with mechanically connected piping: leaks, gasket changes, bolt tightening, caulking, threading, difficult covering, and other inefficiencies that can seriously hamper war production.

REMEMBER these common-sense facts before you install new piping systems or replace old sections: welding with Tube-Turn fittings insures *permanently leakproof, trouble-free joints* and better fittings that last as long as the pipe itself. You banish many maintenance troubles which seriously interrupt the vital *piping arteries* that keep war plants going.

In addition, Tube-Turn welding fittings give you *greater strength and safety;* uniform wall thickness, for *easier, faster alignment and welding;* compact piping layouts that *save space, weight and installation time;* smooth inner walls that mean far *better flow, less corrosion* and *greater piping efficiency.*

TUBE-TURNS (INC.), LOUISVILLE, KY. *Branch offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Tulsa, Houston, Los Angeles. *Distributors in principal cities.*

TUBE-TURN
TRADE MARK
Welding Fittings

NDHA to Meet in Pittsburgh

PITTSBURGH — The program of the 34th annual meeting of the National District Heating Association to be held here June 9-10, with headquarters at the Hotel Schenley, provides for four full sessions.

Particular interest to heating and ventilating men in general are the reports of the Commercial Relations Committee and the Research Committee. The report of the former committee, of which George H. Tuttle of the Detroit Edison Company is chairman, will be heard on the afternoon of June 9 and will include the following papers:

"Heat Consumption of the Two Research Committee Typical Buildings", F. Lee Rapson, Consolidated Gas Electric Light and Power Company.

"Hot Water Consumption of Buildings", Albert F. Metzger, Allegheny County Steam Heating Company, Pittsburgh.

"Changes in Hot Water and Steam Use Due to the War".

"War Time Commercial Activities of Class A (utility) Members", Mr. Tuttle.

"Results of Fifty-nine Automatic Temperature Control Installations", Mr. Tuttle.

The Research Committee, of which A. R. Mumford, Combustion Engineering Company, New York, is chairman, will include a paper on Basis of Comparison for Heat Used in Different Types of Buildings in Different Cities. In addition, John F. Collins, Jr., secretary of the NDHA, will present a Progress Report on Weather Statistics.

The grand-daddy of Tube Turns, 30 inches inside diameter, the biggest welding-ell ever made by Tube Turns, Louisville, manufacturers of welding fittings. This 180° return can be used as such, but in this instance will be cut apart into two 90° ells, for use on huge, self-propelled floating drydocks now being constructed by the U. S. Navy. A baby turn, a half-incher, is held up for comparison.

Roberts Addresses ASRE

CHICAGO—Ben E. Seamon, president of Westland Engineering Supply Co., was elected chairman of the Illinois section, for the 1943-44 term, at the annual dinner-meeting held April 15th. Others elected as vice chairmen were Professor Burgess H. Jennings, Northwestern Technological Institute, William S. Bodinus, Carrier Corporation, and Clarence Sieben, Sieben Brewery, as secretary.

Chapin Roberts, engineer of Sears, Roebuck & Company, spoke on "Air Conditioning in Sears, Roebuck Stores."

ASHVE Semi-Annual Meeting Program

NEW YORK — The Pittsburgh chapter of the ASHVE will act as host for the 1943 semi-annual meeting to be held at the William Penn Hotel, June 7-8.

The customary entertainment features are being omitted and the only important social function will be the semi-annual dinner June 8 at which the principal speaker will be Dr. Allen A. Stockdale whose subject is Democracy Can Do It.

The technical program follows:

June 7—9:30 a.m.—Reports of Officers; Amendments to By-Laws. Performance of a Residential Panel Heating System, by H. F. Randolph and J. B. Wallace. Operation of a Heating Plant Using Sun Energy and Radiant Heating, by W. C. Knopf, Jr.

June 7—2 p.m.—Final Values of the Interaction Constant for Moist Air, by John A. Goff, J. R. Andersen and S. Gratch. Study of Actual vs. Predicted Cooling Load on an Air Conditioning System, by J. N. Livermore. Spray Nozzle Performance in a Cooling Tower, by L. M. K. Boelter and S. Hori.

June 8—9:30 a.m.—Use of the Down Draft Coking Principles for Smokeless Combustion, by J. R. Fellows and J. C. Miles. Field Study of Comfort Reactions of Apartment Dwellers Under Fuel Oil Rationing, by Sallye Hamilton. Heat Transmission Through Insulation as Affected by Orientation of Wall, by F. B. Rowley. Graphical Method of Calculating Heat Losses, by P. D. Close.

June 8—2 p.m.—The Economic Factors in Converting Recirculated Air For Ventilation, by H. E. Ziel and Henry Sleik. Panel Discussion—Will Current Ventilating System Operation Undermine Public Health and Efficiency?

12th Forced Air Conference Held at Michigan State

EAST LANSING—The Twelfth Annual Forced Warm Air Conference, sponsored by the National Warm Air Heating and Air Conditioning Association, held at Michigan State College here in March, included an attendance of 75 representatives of manufacturers, jobbers, dealers and contractors.

A forced warm air heating system of a five-room residence was completely designed and heat loss figured even to the balancing of the system. This part of the program was presented by instructors J. Earle Maynard, Rybolt Heater Co., Ed. Root, Superior Safety Furnace Pipe Co., Guy Voorhees, Hall-Neal Furnace Co., and Professor C. H. Pesterfield, Michigan State College.

You are looking at the largest paint-spray booth in the world, where complete 4-engine bombers are painted in one operation. To the left you see part of the Dust-Stop air-filter installation through which 700,000 CFM moves. The filter bank consists of 3648 Dust-Stops.

How Dust-Stop Air Filters help in aircraft painting

Spray-painting planes is now a matter of camouflage, not looks.

So—keeping the dust out of the air in a paint-spray booth is still highly important.

For painted wing and fuselage surfaces must be as smooth as possible. A surface roughened by dust could impair the aerodynamic efficiency of a plane. Then, too, clean filtered air is required to insure the paint operators efficiency by helping provide ideal working conditions.

The reasons why Dust-Stop* Air Filters are used in the largest paint-spray booth in the world (pictured above) are obvious: high efficiency, low installation and maintenance costs, and easy availability of replacement filters.

As original equipment for commercial and industrial installations, Dust-Stops cost only about 1¢ per CFM to install. They cost less than 1/10th of a cent per CFM to replace.

It is the combination of these points of superiority that makes Dust-Stops the Number 1 air filter in plants making bomb sights, tanks, precision instruments, and in nearly every other type of war industry.

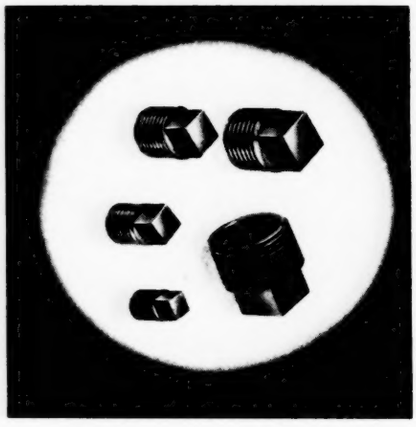
If you have an air-filtering problem, Dust-Stops can probably help you. Write today for complete engineering data and information.

Owens-Corning Fiberglas Corporation, Toledo, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.

FIBERGLAS* DUSTOP* AIR FILTERS

*T. M. Reg. U.S. Pat. Off.

NEW EQUIPMENT

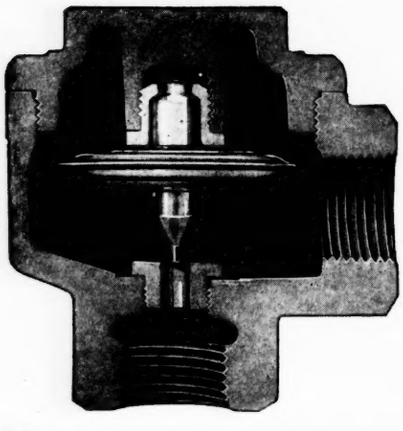


Plastic Pipe Plugs

NAME—Plastic pipe seal plugs.
PURPOSE — For protection of pipe threads in storage or in transit.
FEATURES — Molded from a tough, durable plastic, these standard size plugs are said to furnish complete protection against physical damage, or moisture, dirt, weathering, rust and corrosion.
SIZES—⅜, ½, ¾, and 1 in. SPT.
MADE BY—*American Molded Products Co., 1644 No. Honore St., Chicago, Ill.*

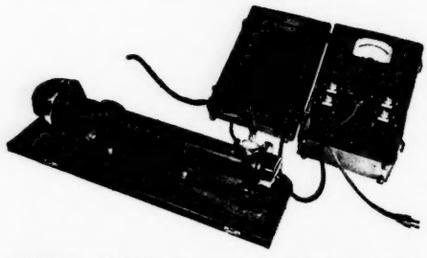
Cast Iron Trap

NAME — Victory thermostatic steam trap.
PURPOSE—To replace cast brass body traps.
FEATURES — Conforms with WPB program of critical metal saving by using all cast iron body and cover. Has phosphor bronze diaphragm and renewable brass needle and seat, and female inlet and outlet connections with left hand inlet thread and right hand outlet. Furnished in angle pattern only. Diaphragm is stated to be self-equalizing, with an operating range from vacuum up to 15 lb.
SIZES—Made in three sizes: ½ in. for 200 sq ft; ¾ in. for 400 sq ft; and ¾ in. for 700 sq ft.
MADE BY — *Jas. P. Marsh Corporation, 2073 Southport Ave., Chicago, Ill.*



Smokemeter

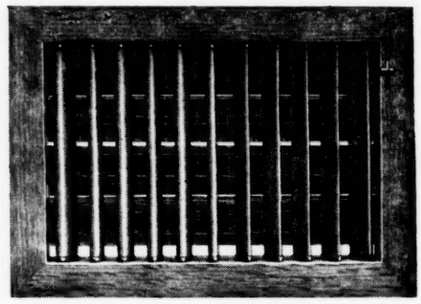
NAME—Photoelectric Smokemeter.
PURPOSE—For registering concentrations of suspended particles in a gas, particularly combustion gases.
FEATURES—Consists of a metal tube with a photocell at one end and a lamp at the other, mounted on a wooden base and equipped with a suction fan and connections by which smoke-laden gases can be drawn through the tube; also a metering apparatus for use in conjunction. Light from the 6-volt lamp passes through the tube and impinges on the photocell, the current output of which is registered by a sensitive microammeter. Control is adjusted for full scale deflection with clean air in the tubing, and when smoke is present the needle moves to the left and its indication is read directly as percent of smoke density.



SIZES—Made in one stationary and two portable models.
MADE BY — *Photovolt Corporation, 95 Madison Ave., New York, N. Y.*

Non-Metallic Grilles

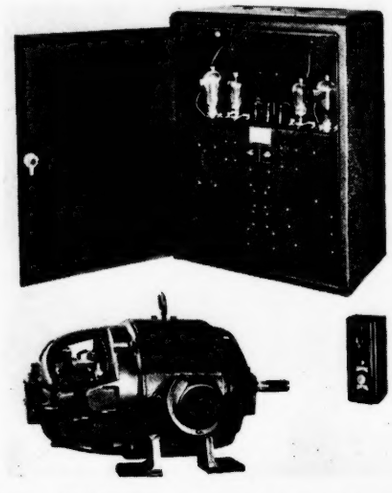
NAME—Presdwood grilles and registers.
PURPOSE—For directing and controlling flow from air outlets.
FEATURES—Frames and bars are made of presdwood with bar ends capped with steel. Single adjustable grilles have either vertical or horizontal bars adjustable through 90° rotation. The double adjustable type has both horizontal and vertical bars. Both single and double types are furnished as registers by incorporation of multi-shuttered dampers which are operated by means of a convenient lever on the face of the register. All grilles and registers furnished in a standard flame-proof fire resistant prime coat finish. Wide spacing of bars permits easy application of final coat.
SIZES—Range of sizes same as the



company's standard steel grilles and registers as listed in Catalog No. 41.
MADE BY—*Tuttle & Bailey, Inc., New Britain, Conn.*

Electronic Motor Control

NAME—Mot-O-Trol drive.
PURPOSE—For close regulation, over a 20 to 1 speed range, of d-c motors operating from an a-c source.
FEATURES—Drive consists of (1) power transformer; (2) Mot-O-Trol cabinet with thyratron-tubes and control for regulating current and speed; (3) control station with potentiometer to vary armature and field voltage and with start and stop push buttons; and (4) shunt-wound d-c motor. Incoming a-c power is converted to d-c by grid-controlled rectifier tubes and supplied to the d-c motor. Constant torque for all speeds up to the base speed of the motor, and constant horsepower above this speed range, are provided. Speed variation held within 8% over a 20 to 1 speed range, with torque varying from low load to full load.
SIZES AND CAPACITIES—Present standard drive available up to 1 horsepower, in single phase, 110 or 220 volt, 60 cycle. Special design for larger drives.
MADE BY—*Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.*



Springboard for Airpower

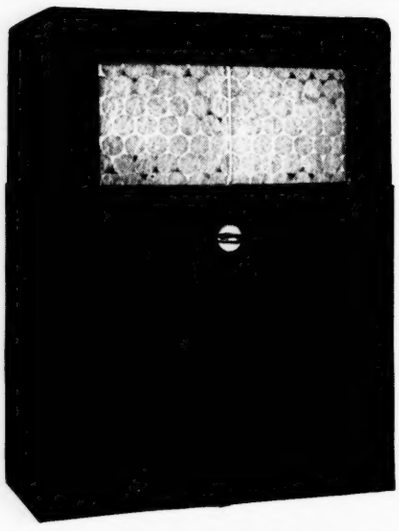
Just strips of steel 18 inches wide by 10 feet long, punched full of holes and made so that when you lay them down side by side, they lock together.

But assemble some thousands of these strips and you have a potent weapon—a military runway. Runways made in this way are serving as springboards from which Flying Fortresses, Grumman Wildcats and A-20-A's are being launched against the Japanese north of Guadalcanal, and against the Nazis in North Africa.

Bethlehem's main job in the landing mat program is supplying a tremendous tonnage of sheet steel to many fabricators for processing into these mats. Monthly production has been growing fast, and has already reached a figure that might mean something to an enemy ad-reader, so we can't quote. But when you realize that just one military runway eats up 3,000,000 pounds of sheet steel, you get an idea of the magnitude of the program. Supplying steel for landing mats is only one of the many ways in which Bethlehem is working to aid our armed forces.

Due to the great need for landing mats in a hurry, Bethlehem Steel Company has converted a portion of its building specialty department to the production of these mats for the duration of the emergency.

BETHLEHEM STEEL



Portable Dust Collector

NAME—Safe-Aire portable dust collector.

PURPOSE—For dust removal and air recovery.

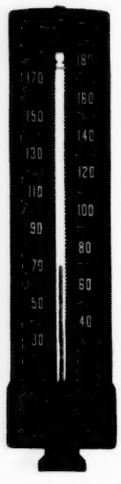
FEATURES—Dust-laden air from industrial operations such as grinding and buffing is forced at high speed into a small cyclone which separates the heavier particles, the air then passing through a spun glass filter where the balance of the dirt is almost entirely removed. The filtered air returns to the room at a temperature slightly higher than its entering temperature. Working parts are housed in an all-welded metal cabinet. The filter pad is said to be the only part requiring replacement. A filtering efficiency of 97% is claimed.

SIZES—Overall dimensions, 37 in. high, x 27 in. wide, x 13 in. deep, with 600 cfm fan.

MADE BY—*Bargar Sheet Metal Co., Cleveland, Ohio.*

Steel Case Thermometer

NAME—American pressed steel case glass thermometer.



PURPOSE—For registering temperature.

FEATURES—Thermometer has a reinforced pressed steel case replacing the critical cast bronze formerly used and employs a new method of scale manufacture which is said to produce a more legible and better-looking product. Scale is black with yellow figures and the tube is red-reading mercury. Cover screw attached to instrument so it cannot be lost. Case is said to be sturdy and practically corrosion proof. Finished in black suede.

MADE BY — *American Schaeffer & Budenberg Instrument Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn.*

Odor Absorber

NAME—Tamms Nox-Odor.

PURPOSE—For absorption of objectionable odors and excessive humidity in enclosed places.

FEATURES—Product is a hygroscopic porous granular material which, when hung in mesh bags in the space to be conditioned, absorbs the odors and moisture from the air.

MADE BY—*Sills, Troxell & Minton, Inc., 209 South LaSalle St., Chicago.*

Asbestos Cement Conduit

NAME—Asbestos cement conduit.

PURPOSE—For underground cable installation.

FEATURES—Made of non-critical materials, product is said to be exceptionally tough, hard and dense, strong and highly resistant to shock and to be impervious to ground corrosion. An exclusive coupling, *Flexcaulk*, gives a flexible, self-aligning water-tight joint when used with special joint sealing compound.

MADE BY—*The Philip Carey Mfg. Co., Lockland, Cincinnati, Ohio.*

New Metal Finish

NAME—Armo-Vit.

PURPOSE—A corrosion-proof coating for steel and other non-critical metals.

FEATURES—This material is essentially an alkali alumina silicate baked on iron or steel at 750 to 800F in either one or two coats, .0005 in. or .0010 in. thick. Described as being unlike either ceramic coverings or such organic finishes as paints, lacquers, and synthetic enamels, the new coating is said to be exceptionally hard and heat-resisting, insoluble in boiling water, and highly resistant to most acids and alkalis as well as to impact and abrasion. The exhaust pipe illustrated shows the uncovered portion of the pipe badly corroded after five months' exposure with the shiny coated end practically unchanged.

MADE BY—*Chicago Vitreous Enamel Product Co., Cicero, Ill.*

Condensers and Coolers

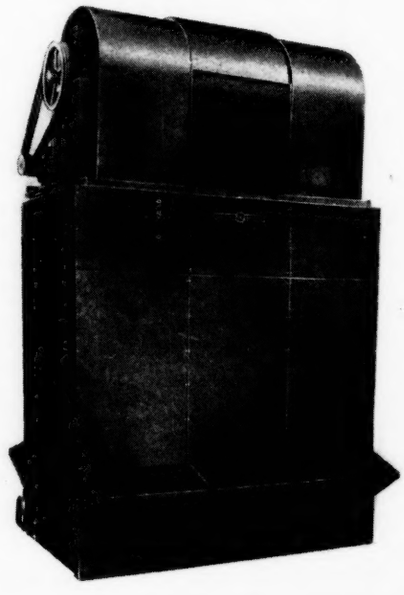
NAME — Evaporative condensers, evaporative coolers.

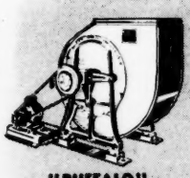
PURPOSE — For refrigeration and cooling.

FEATURES — Redesign for the purpose of saving critical metals has resulted in a new line of units. Each standard unit consists of one or more all-welded steel basic spray cooler sections, fan sections and small subassemblies, and the units are said to be compact and light in weight, separately demountable, and individually serviced and replaced. Sand blasted steel casings and frames are finished with three baked enamel coats and one air-dry coat of blue gray enamel. Heat transfer surface made up of standard weight bare pipe, bonderized before enameling.

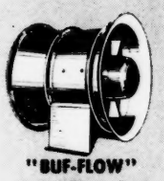
SIZES—Coolers: basic ratings from 250,000 to 3 million Btu's per hr; condensers: 67,750 to 813,000 Btu's per hr.

MADE BY — *General Electric Company, Bloomfield, N. J.*



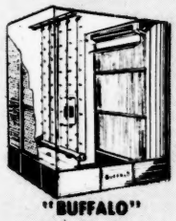


"BUFFALO"
Limit-Load Ventilating Fan

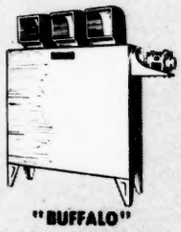


"BUF-FLOW"
Axial Flow Fan

"BUFFALO"
MX Mill Exhauster

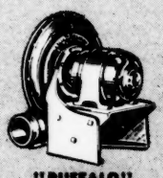


"BUFFALO"
Air Washer



"BUFFALO"
Highboy Unit Heater

"BUFFALO"
Breeze Ventilating Fan

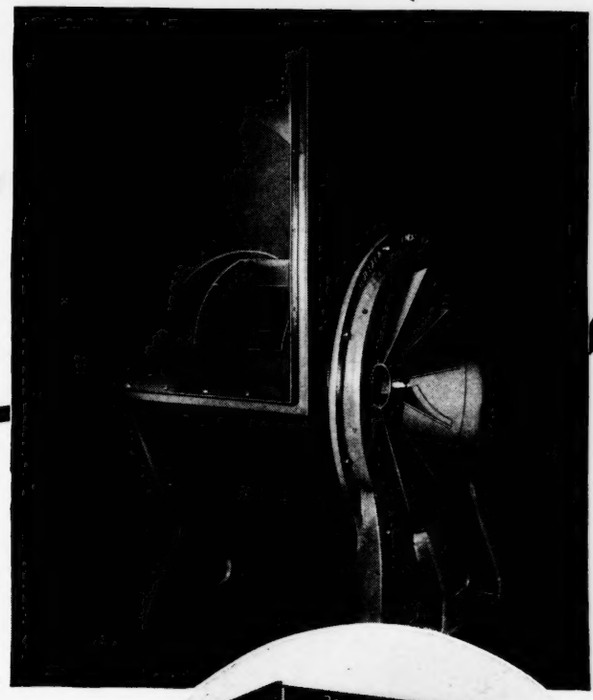


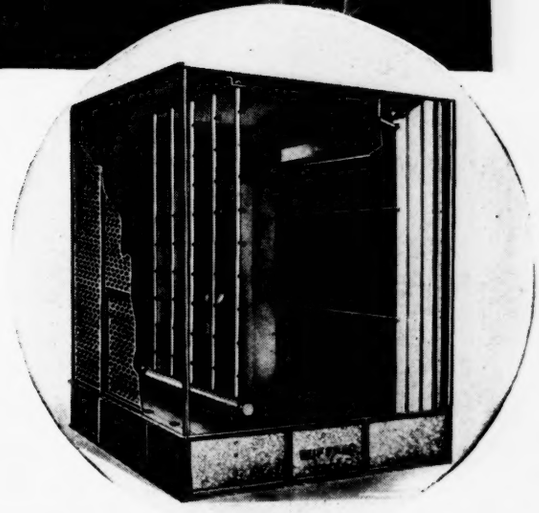
"BUFFALO"
Type E Blower

"BUFFALO"
Volume Fan

Sure... there's a wartime shortage of air conditioning equipment *but*

HERE'S ONE WAY TO MEET THE PROBLEM NOW!





Yes, here's a practical way to bring your plant many of the benefits of air conditioning—despite the shortage of complete air conditioning equipment. Buffalo Ventilating Fans, in combination with Buffalo Air Washers, provide clean, dust-free air, properly humidified—the kind of plant atmosphere that keeps up workers' efficiency and morale every season of the year and helps safeguard quality production. Readily installed at low initial cost, Buffalo equipment provides NOW a satisfactory answer to your air conditioning problem.

Complete engineering data will be forwarded promptly on request

BUFFALO FORGE COMPANY

480 Broadway Buffalo, N. Y.

Branch Engineering Offices in Principal Cities
Canadian Blower and Forge Co., Ltd., Kitchener, Ont.

"Buffalo" VENTILATING FANS AND AIR WASHERS

REVIEWS of TECHNICAL publications

INDUSTRIAL HAZARDS

"Exploring the Dangerous Trades—The Autobiography of Alice Hamilton, M.D. Published by Little, Brown & Co., Boston; An Atlantic Monthly Press Book. Price, $3. Reviewed by John F. Sheehan.

It takes a great deal of self-assurance to write an autobiography. This fact alone might make the general reader shy away from such a book—in this case to the reader's loss. It is not really an autobiography but an eye witness account of the origins and development of many of the major trends in labor relations and industrial hygiene.

Dr. Hamilton's span of activity coincides with the era of greatest change particularly in those fields where her natural interests were most pronounced. She is essentially a practicing sociologist. Her early life, training, influences, even her inheritance, seem to have constituted just the proper ingredients to condition her for the rather unique part she later played.

Here and there she muses on the difficulties and prejudices encountered—merely because she was a woman. Had she been a man and followed her natural bent—as she did—she probably would have ended up as an obscure practitioner in some small town—but without an autobiography.

A crusader but no zealot, she maintains a balanced viewpoint in retrospect. Her judgment of the average industrialist is nicely tempered. She contends that selfishness was rarely the sole motive underlying the continuance of dangerous working conditions. Once her case was reasonably proven she admits her missionary work among the tycoons was relatively easy. She generally attributes the error of their ways to ignorance rather than greed. Numerous experiences are quoted in point.

Without a hint of boasting she derives considerable satisfaction in the knowledge that most of the pernicious conditions that obtained in many industries have either disappeared or have been brought under positive control. Thanks for this is given to state and federal legislation of various kinds, as well as to mechanical and engineering advances.

Dr. Hamilton's book provides a coherent and rather cohesive historical background in the field of modern industrial hygiene. The social, political, economic and industrial strands are so woven that the reader gradually becomes conscious of the profound natural relationship between them and the cause to which she has devoted her adult life—the general welfare of the industrial workman.

INSULATING BOARD STANDARD

"Recommended Revision of Fiber Insulating Board, Commercial Standard CS42-35." Published by the National Bureau of Standards, Washington, D. C.

Definite criteria of insulating value and other minimum physical requirements for five classes of structural fiber insulating board are covered in this recommended revision. These classes are: A—Building board; B—Lath (for plaster base); C—Roof insulation board; D—Interior board (factory finished); and E—Sheathing.

The revised standard is being circulated for acceptance by producers, distributors, and users and is intended to promote a common understanding throughout the insulating board industry.

HEATING APPLIANCE INSTALLATION

"Clearances and Insulation of Heating Appliances, Bulletin of Research, No. 27, Feb., 1943." Published by Underwriters' Laboratories, Inc., 161 Sixth Ave., New York.

In order to provide better agreement among various building codes, ordinances, and insurance standards on recommended safe clearances between heating appliances and adjacent combustible materials, tests, simulating as closely as possible actual field conditions, have been conducted.

Some 8550 temperature readings were recorded and a limiting factor of 90F material temperature above the temperature of the room was used. Results of the tests with different materials and under different conditions are shown in the form of graphs. While not entirely conclusive the data noted should provide a basis for a greater degree of uniformity among the various ordinances and regulations.

Booklet has 40 pages, 6 x 9 in., paper covered.

CONVERTING TO COAL

"Oil to Coal Conversion." Published by the Industrial Press, 148 Lafayette Street, New York, N. Y., from HEATING AND VENTILATING, May, 1943. Price, 25c.

Instructions covering the various factors to be considered in converting medium and large sized oil installations to coal, including a listing of the various steps necessary in securing WPB approval on equipment and parts, how to size stokers, and making the survey, are given in this 32-page HEATING AND VENTILATING's Reference Section No. 10. Numerous sectional diagrams and photos of actual conversions illustrate installation methods, together with a brief discussion of use of waste heat. The pamphlet is printed in red and black.

For coal, gas, and oil
Made in 6 sizes (300,000 - 1,700,000 BTU)

What More Can You Want?

DIRECTHERM

UNIT HEATERS STOKER-FIRED

LOW-COST HEAT

+ QUICK INSTALLATION

+ EVEN TEMPERATURE

+ METAL CONSERVATION

+ NO MAINTENANCE

= **DIRECTHERM UNIT HEATERS**

AIRTHERM

MANUFACTURING COMPANY

722 S. SPRING AVE., ST. LOUIS, MO.

The
SILVER SIDE *of the* FUEL OIL "CLOUD"

Do you realize that every newspaper and every radio station in America has been "selling" oil burners during the past winter?

Yes, *selling* them! Not directly, of course. Nor intentionally. Yet publicising them as no private advertising campaign could hope to do.

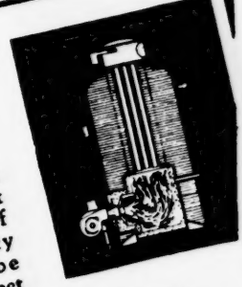
Every American who can read, now knows how regretfully the owners of oil burners converted to coal. And now knows that oil burners are a *major* factor in heating the nation's homes, offices and factories. Two-inch headlines and spot-news broadcasts have told the story as it never has been told before.

Already it is apparent that the public has a new interest and a new appreciation of oil burners. The Gallup Poll reports: 7% of the people questioned in a recent poll said their first major purchase after the war would be an oil burner.

It is our belief that untold opportunities for new usefulness are being opened up for the Oil Burner Industry. Every ounce of energy which we of the S. T. Johnson Co. can spare from building Aqulux Water Heaters for the needs of Uncle Sam, is being used to plan for a still bigger job in happier years ahead. S. T. Johnson Co., 941 Arlington Avenue, Oakland, California, and 401 No. Broad Street, Philadelphia, Pa.

AQULUX

Heavy Duty
WATER HEATERS



Though the Army and Navy are taking most of our production of these high-efficiency heaters, we may be able to help you meet hot water problems for War Industry or Military installations. Aqulux heaters are built with capacities up to 540 gal. per hr. and in 4 basic types. We will gladly send detailed information.

S. T. JOHNSON CO.

40 years of engineering and building fine Oil Burning Equipment

CONTROLS

Mercoid Corporation
4201 Belmont Avenue, Chicago, Ill.

Standard size, 64-page, general catalog No. 600 illustrates and describes the company's complete line of controls for air conditioning systems, blowers, boilers, gas pilots, main burners, refrigeration systems, and other devices and processes. Booklet has attractive three-color cover.

FILTERS

Owens-Corning Fiberglas Corporation
Toledo, Ohio

A standard size, 28-page catalog lists the correct sizes of Dust-Stop air filters for practically every make and model of domestc forced warm air furnace and air conditioning unit. The number of filters required for each application is also shown.

PIPE WELDING

Tube Turns, Inc.
Louisville, Ky.

A new 4-page, 8½ x 11½ in., two-color folder is No. 1 in a series of case studies on improving marine piping practice by the use of welding. Comparative data and drawings on a typical auxiliary exhaust section designed with the company's standard welding fittings as against other methods of construction are given.

WELDING

Air Reduction Sales Co., Inc., New York, N. Y.

A 16-page reprint entitled "The Welding of Piping," by Arthur N. Kugler, made up of a series of three articles which appeared in May, June, and July, 1942 issues of HEATING AND VENTILATING, is available from the above company. A complete coverage of practical and theoretical considerations governing the gas welding of steel, iron, and non-ferrous piping is given.

BLOWERS

Torrington Manufacturing Co.
Torrington, Conn.

Complete information on the company's blower wheels is given in a new 64-page catalog. Included are performance ratings, specifications, and other data. Ratings of all wheels shown in previous catalog have been re-checked. Two new sections are included in the book.

PIPE WELDING

Tube Turns, Incorporated, Louisville, Ky.

A history of piping and its importance to industrial development throughout the ages is interestingly portrayed in a 12-page, 10 x 14 in. booklet, printed in two colors, called "The Romance of Piping." This constitutes the spring 1943 issue of "Sparks," the company's house organ.

AIR CONDITIONING

Carrier Corporation, Syracuse, New York.

A new 12-page booklet giving general information, typical application data, specifications and features of 16 types of the company's equipment is available. The field covered includes temperature and humidity control, refrigeration, and heating and ventilating.

UNIT HEATERS

Modine Manufacturing Company, Racine, Wisconsin.

A 9 x 12 in. wall chart, convenient for hanging in plant operating departments and intended for the guidance of maintenance men in the upkeep of unit heaters, is available from the manufacturer.

PUMPS

Allis-Chalmers Mfg. Company, Milwaukee, Wis.

"Handbook for Wartime Care of Centrifugal Pumps" is a new 5 x 7 in. 28-page handbook, the third of a series which already includes similar booklets on the care of motors and V-belts. Animated cartoons accompanying the text give a step-by-step picture of how a centrifugal pump is built and in the same way show some of the serious consequences arising from neglect of important maintenance operations. Booklet contains no advertising and applies to all makes of centrifugal pumps.

CONTROLS

The R. W. Cramer Company, Inc.
Centerbrook, Conn.

Bulletin 3000, standard size, 4 pages, illustrates and describes the operation of multi-contact timers used for the operation in predetermined sequence of a series of signals, valves, solenoids, and similar devices.

FEED WATER TREATMENT

Cochrane Corporation, 17th & Allegheny Ave., Phil., Pa.

Bulletin No. 3005 devotes 36 pages to the operation of tray-type and atomizing deaerators, deaerating hot water generators, and cold water deaerators. Operation of the equipment is described and clarified by use of cross section photographs and line diagrams in color. Flow diagrams and discussions of corrosion control and control of pH value are included.

GASKETS

Goetz Gasket & Packing Co., Inc., New Brunswick, N. J.

The first of a new series of technical bulletins designed to give complete and interesting information on gaskets of various kinds, describes laboratory facilities and test methods used in determining hitherto unknown factors in gasket engineering. Those interested in receiving the complete series of bulletins should apply on a company letterhead direct to the manufacturer.

TRAPS

W. B. Connor Engineering Corporation, New York, N. Y.

A new 4-page standard size folder illustrates and describes the functioning of the improved Corliss valve ACE steam trap which operates on the rotary valve principle. Dimension tables as well as size and capacities are given.

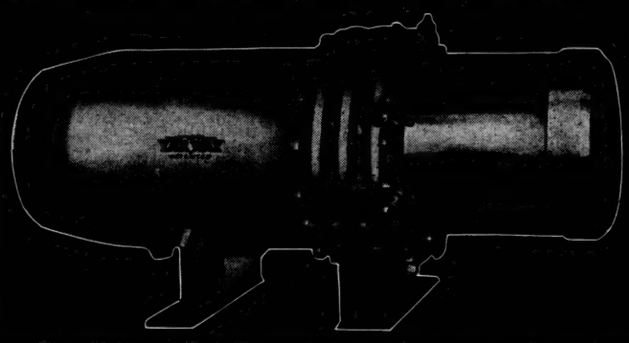
YARWAY GUN-PAKT EXPANSION JOINT

It is packed under full steam pressure. By the turn of a wrench, integral pressure guns force a special semi-plastic packing into the stuffing box.

Welded Steel Construction. Alemite lubricated cylinder-guided sleeve. Made also in conventional gland-pakt types. Write for Bulletin EJ-1908.

•

YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA



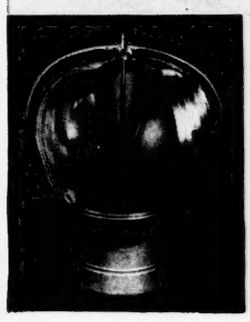
Alnor VELOMETER

Direct Reading of Air Velocities

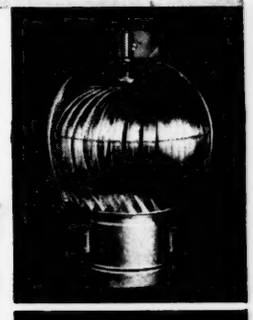
Illustrated at the left is an application of the Alnor Velometer to the checking of air velocities of a narrow slotted supply grille. Readings are instantaneous on the dial calibrated in feet per minute. Note how the spot angle jet is ideal for this particular purpose. Numerous other jets make this precision instrument applicable to almost every possible situation—under hoods, in plenum chambers, ducts, grilles, etc. The Alnor Velometer is the one all-purpose, instantaneous, direct-reading, fool-proof instrument for checking, with utmost convenience and accuracy, air velocities and static (or total) pressures under all conditions. Fully described and illustrated in new Bulletin No. 2448-E; write for your copy.

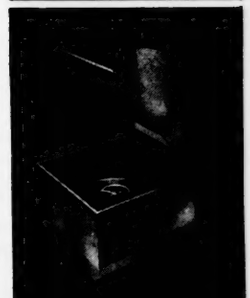
Illinois Testing Laboratories Inc.
143 W. Hubbard St., CHICAGO, ILL.

Fresh Air Is SURE with "ALLEN'S"



A TYPE FOR EVERY NEED





Perfect ventilation is a war-production "must". Let Allen ventilation engineers report on your needs and recommend the most suitable type of equipment. Allen provides wide choice—famous self-operating Coni-Vane Turbines; Electro-Wind Coni-Vane with auxiliary power; Stationary types of various forms. Let ALLENS clear the atmosphere for maximum production!

Send today for fully descriptive and illustrated catalog. Wire or telephone if urgent. Representatives in most principal cities.

The ALLEN Corporation
9767 Erwin Ave. • Detroit, Michigan

"GROSS-AIRE"
COMMERCIAL AND INDUSTRIAL STOKERS

WPB Urges Conversion From Oil to Coal. Our Production Greatly Stepped Up to Meet Increased Demand

Illustrated literature on request to Jobbers, Distributors and Dealers. Wire, write or phone today.

You will be safe with "Gross-Aire"

Our 34 years experience is your guarantee.

GROSSENBACHER FURNACE CO., INC.
Manufacturers of Gross-Aire Stokers and Furnaces
ST. LOUIS, MO.

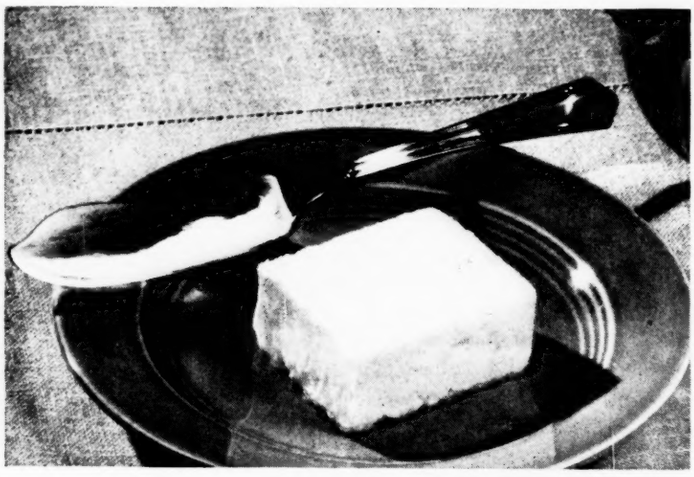
BALDOR MOTORS

Baldor Motors have been standard in the heating and ventilating industry for the past twenty years.

Motors designed for Unit Heaters, Blowers, Pumps and Air-Conditioning equipment. Special design motors for Quiet Operation. Fan-type motors from 1/30 to 20 h.p. **WRITE FOR BULLETINS.**

BALDOR ELECTRIC CO., St. Louis, Mo.
District Offices in Principal Cities

It's Time to Tell About Refrigeration's "*Hidden Services*"



. . *take* BUTTER

for instance . .

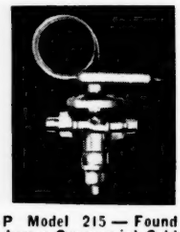
When Mrs. America tears eight precious Rationing points out of her Ration Book for a pound of butter, she little realizes that only because of Refrigeration is that butter made available.

Most rationed foods are perishable, require accurately controlled DEPENDABLE Refrigeration to prevent spoilage and waste. A-P DEPENDABLE REFRIGERANT CONTROL VALVES are helping Mechanical Refrigeration perform this great task of food protection so vital to war today . . . Offering DEPENDABLE, supersensitive Refrigerant Control that keeps Refrigeration units operating efficiently with a minimum of service attention.

AUTOMATIC PRODUCTS COMPANY
2462 NORTH THIRTY — SECOND STREET
MILWAUKEE WISCONSIN
Export Dept. 100 Varick St., New York City

A-P Model 204 — Used in Farm Coolers and Home Refrigerators.

A-P Model 205 — Popular on Retailers' Display cases, Truck Units.



A-P Model 215 — Found in larger Commercial Cold Storage Refrigeration Units.

ap DEPENDABLE *Refrigerant Valves*

WITH THE MANUFACTURERS

FORMICA INSULATION COMPANY

to cope with rapidly increasing volume of business and to get ready for post-war developments, has elected five new vice-presidents: W. J. Gebhart, with the company for 20 years, treasurer since 1936, has been elected vice-president in charge of finances and accounting; J. Roger White has been elected vice-president in charge of sales and advertising. He has been with the company since 1928, formerly in charge of the New York area and for the past three years general sales and advertising manager; George H. Clark, elected vice-president in charge of engineering, has been with the company for 18 years; R. W. Lytle, vice-president in charge of special engineering involving automotive and aircraft engineering, has been associated with the company 20 years; Ellsworth G. Williams, vice-president in charge of manufacturing, was employed in a consulting capacity for the past three years and previously associated with a Cleveland engineering firm; and Walter H. Kruse, associated with the company since 1914, office and credit manager since 1928 and assistant secretary since 1936, was elected secretary.

MINNEAPOLIS-HONEYWELL REGULATOR CO.

to provide automatic control of temperature and humidity in the rapidly expanding food dehydration industry, has established a separate food dehydration controls department in the Brown Instrument Co., a division of Minneapolis-Honeywell. Brown engineers have been working closely with experts of the Department of Agriculture, food processors and manufacturers of drying equipment in developing new processes and improving present methods. The new department we have established will correlate the results of continuing research into the control problems of the industry. The new division, functioning through the 58 field offices of Brown and Minneapolis-Honeywell, is prepared to advise food dehydrators and manufacturers who are considering entering the field.

BARBER-COLMAN COMPANY

announces the appointment of the J. E. Redmond Company, 448 West Madison St., Phoenix, Ariz., as its distributor for temperature control and ventilating products for Arizona, New Mexico, and that section of Texas west of the Pecos River.

WESTINGHOUSE AIR BRAKE CO.

Wilmerding, Pa., announces that its accumulated experience in the development and manufacture of pneumatic controls for the railroads of the world now is to be made available to the general industrial field. The company's remote control systems already have been installed in the marine field for the control of ships. Similar applications have been made on power shovels and to help solve control problems in the mining, petroleum and machine tool industries. Among other industries being studied under the broadened industrial program are those requiring controls involving a sequence of operations, such as armament equipment, automotive, aviation, building construction, ceramic, lumbering, metal working, paper manufacturing and plastic. The new systems will be marketed by the company's industrial division.

PETROLEUM HEAT AND POWER CO.

Stamford, Conn., announces that K. G. MacCart, vice-president and treasurer, has assumed, in addition to his other duties, executive direction of the company's manufacturing and marketing activities. This position was formerly held by C. E. Shields, who resigned March 24. Mr. MacCart completed his education at Massachusetts Institute of Technology and prior to joining Petro in 1932 was associated with large organizations dealing in petroleum products. He was elected assistant treasurer of Petro in 1939, became treasurer in 1940 and was elected vice-president and a director of the company in 1942.

Mr. MacCart's executive staff will be composed of men who have headed various departments of the company for some time past: J. F. Corrigan, formerly promotion and advertising manager, has been appointed director of marketing; Mr. Corrigan has been with Petro since 1936; he is a director of Oil Heat Institute, and prior to joining Petro directed marketing and promotional activities of several national organizations; W. A. Bulger continues as chief engineer, a post he has held since 1929; Mr. Bulger was chief engineer for the American Nokol Company from the formation of that company in Chicago shortly after the close of World War I up to the time it was absorbed by Petro in 1929. Except for a four-year period in which he was industrial engineer for the People's Gas Company in Chicago, Mr. Bulger has been continuously in the oil heating industry and has been a leading figure in engineering development in that line; T. G. Hughes has been appointed production manager and assumes immediately the direction of the company's factory operation. He will be assisted by Herman Boethjer, plant superintendent.

The Stamford plant of Petro has been totally devoted to war production for over a year, and has more than doubled its capacity and output in that time. In normal times the company had an international business in oil burning equipment and is one of the larger marketers of fuel oil on the eastern seaboard. Realizing the need for post war planning by industry, the company's management is developing an extensive post-war program which will include refinements of present oil-burning equipment and a study of products in related fields.

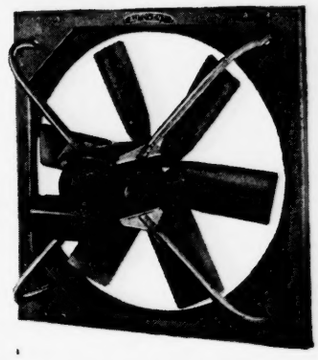
CRANE CO.

elected Harry F. Potter as secretary at a recent meeting of the board of directors. Since 1931 he has been manager of branch houses, and is succeeded by James A. Dwyer, manager of district No. 1. Mr. Dwyer joined the Crane organization in 1917 at the Philadelphia branch, becoming manager in 1935. Two years later he was appointed district manager with headquarters in the New York branch. In his new position of manager of branch houses, he will be assisted by A. H. Prasse. David J. Molloy, assistant manager of the New York branch, succeeds Mr. Dwyer as district manager, and will have general supervision of the main branches in Baltimore, Boston, New York, Philadelphia, and Washington, D. C., plus their subbranches—a total of fifteen. He in turn, is followed by George P. Gregory, Jr., as assistant to the manager of the New York branch.

SUMMER HEAT AHEAD . .

Good Ventilation Promotes Efficiency...Reduces Absenteeism

HERMAN NELSON
Autovent
DIRECT DRIVE
PROPELLER FANS



DRIVE out summer's sluggish air with powerful Herman Nelson Autovent Propeller Fans. . . . Exhaustive tests in plants, factories and commercial establishments proved that the better working conditions made possible by an efficient ventilating system speed up production, lower the number of accidents, and reduce mistakes and time lost because of illness. Subsequently, absenteeism too is reduced. . . . Herman Nelson Autovent Propeller Fans operate efficiently and economically, even under severe conditions. They are ruggedly constructed to give many years of trouble-free service. Direct or belt drive designs. Available in wheel diameters 10 to 54 inches, capacities 670 to 22,690 cubic feet per minute.

SEND FOR FREE BOOKLET featuring Herman Nelson Autovent Propeller Fans for Ventilating Public, Industrial and Commercial Buildings.

Sales and Service Offices in Principal Cities

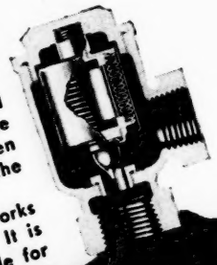
The Herman Nelson Corporation MOLINE ILLINOIS

Autovent Fan & Blower Division, Chicago, Illinois

Manufacturers of
QUALITY HEATING, VENTILATING AND AIR CONDITIONING PRODUCTS

GUARDING INDUSTRY'S COAL PILE

Fuel is ⅓ the transport tonnage in the U. S. A. Dead condensate or air in a steam coil wastes fuel and slows up production. The Sarco Steam trap illustrated on this page says "get out" to spent condensate and gases — and "wait a while" to anything above its discharge temperature. It is so inexpensive that it can be used on each steam coil, so no one part of the job can hold up another. Also it's wide open when cool — giving a quick start in the morning. Obviously it cannot freeze. It is small, light, easy to install and works on all pressures within three ranges. It is the only thermostatic steam trap made for pressures up to 250 lbs. Ask for Catalog No. 250.



Sarco No. 9 Thermostatic Steam Trap

144

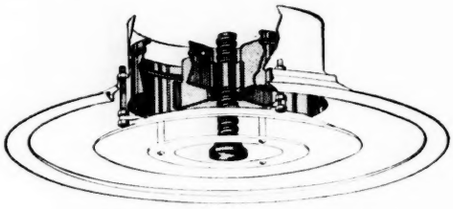
SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
Sarco Canada Ltd., Federal Bldg., Toronto, Ont.

KNO-DRAFT K-NEWS

AIR VOLUME CONTROL IS IMPORTANT, TOO

The effectiveness of air diffusion and distribution is increased by air volume control at each individual outlet—especially when such volume control does not alter the diffusion characteristics.



Cutaway diagram of Kno-Draft Air Diffuser equipped with Type Dee Air Volume Control*

Patents Pending

A *plus* in efficient diffusion, KNO-DRAFT Type DEE Air Volume Control is furnished completely assembled within the diffuser—adjusted and ready to operate. Descriptive Folder–F on request.

**Formerly known as Dorex Kno-Draft Air Diffuser*

WB CONNOR ENGINEERING CORP

W. B. CONNOR ENGINEERING CORP.
114 East 32nd Street New York, N. Y.

PERSONALS AND PERSONNEL

E. J. DOUCET

E. J. Doucet

has been appointed general sales manager by the Detroit Lubricator Co., Detroit. Mr. Doucet has been associated with Detroit Lubricator for 26 years, and until two years ago was in charge of oil burner equipment sales for the Western territory with headquarters at the company's Chicago office. Subsequently, he was transferred to the main office at Detroit where he held the position of sales manager in the oil burner equipment division, and then sales assistant to the president, a position he held up to the time of his present appointment as general sales manager.

GEORGE R. ATKINS

has been appointed by The Bristol Company, Waterbury, Conn., as manager of its branch sales office and factory in Akron, Ohio.

R. H. KNIPPING

has joined the Power Specialty Company, Houston, Tex., as a firm member. He will take over the San Antonio, Austin, Corpus Christi territory which he covered some years ago.

LLEWELLYN WILLIAMS

has been appointed to head both the Engineering and Manufacturing Divisions of the York Ice Machinery Corp., York, Pa. Mr. Williams has been vice-president in charge of engineering. Following his appointment, which became effective March 22, Mr. Williams announced new duties for three key executives: John G. Bergdoll, Jr., chief engineer, was appointed as assistant to Mr. Williams to manage the Engineering and Manufacturing Divisions; J. C. Consley was named assistant chief engineer to take over the duties formerly held by Mr. Bergdoll. J. R. Chamberlain, appointed chief mechanical engineer, will take over management of the Mechanical Engineering Department.

RALPH A. PATTERSON

Ralph A. Patterson

has been appointed sales manager of Bell & Gossett Company. Mr. Patterson was formerly in charge of the company's Philadelphia office but will now make his headquarters at the home office in Morton Grove, Ill.

A. L. GOLAY

has been appointed to its refrigeration application engineering and service staff by Kold-Hold Mfg. Co., of Lansing, Mich., effective March 29. Mr. Golay will cover Missouri, Iowa, Kansas, Nebraska and part of Minnesota, with headquarters in Lansing for the present, with a headquarters to be established in the territory later.

INDUSTRIAL DEGREE DAYS
MARCH, 1943

City	Number of Industrial Degree Days	
	55F Base	45F Base
Baltimore	349	161
Buffalo	766	468
Chicago	723	448
Cleveland	589	341
Detroit	671	405
Indianapolis	610	349
New York	483	215
Philadelphia	398	176
Pittsburgh	487	258
St. Louis	481	259

ARMY – NAVY

AWARDS

Sarco Company, Inc., Bethlehem, Pa.
Schwitzer-Cummins Co., Indianapolis, Ind.
Manning, Maxwell & Moore, Inc., Boston and Bridgeport.
Carrier Corporation, Syracuse, New York. (Re-award).
Merchant & Evans Co., Lancaster, Pa.
Spencer Thermostat Co., Attleboro, Mass.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ladish Drop Forge Co., Cudahy, Wis.

COMING EVENTS

MAY 26—National Warm Air Heating and Air Conditioning Association meeting to be held at the Drake Hotel, Chicago. For further information address George Boeddener, managing director, National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland, Ohio.

JUNE 1-2—30th Spring meeting of the American Society of Refrigeration Engineers, to be held at Hotel Statler, Cleveland, Ohio.

JUNE 7-8—Summer meeting of the American Society of Heating and Ventilating Engineers, to be held at Hotel William Penn, Pittsburgh, Pa.

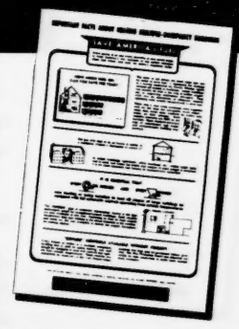
JUNE 8-11—37th Annual meeting of the Smoke Prevention Association, Hotel William Penn, Pittsburgh, Pa.

JUNE 9-10—34th Annual meeting of the National District Heating Association, to be held at Hotel Schenley, Pittsburgh. For further information write John F. Collins, Jr., Sec'y-Treas., 827 N. Euclid Ave., Pittsburgh, Pa.

JUNE 11-12—Heating, Piping and Air Conditioning Contractors National Association. Meeting of Board of Directors and conference of local Secretaries in place of usual convention.

JUNE 21-24—Annual Convention, National Association of Building Owners and Managers, to be held at Hotel St. Paul, St. Paul, Minn.

Uncle Sam wants every building equipped with thermostatic control



● Particularly multiple-occupancy buildings — stores, offices, apartment buildings, hotels, schools, etc.

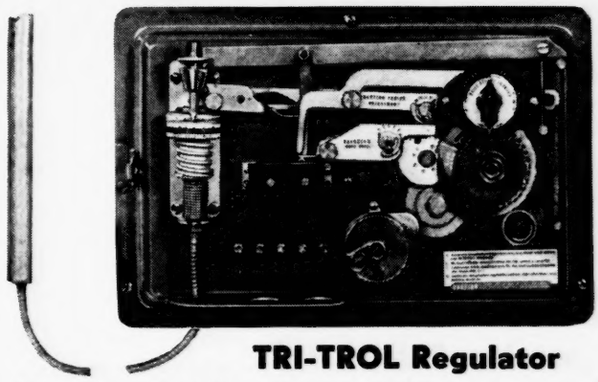
This need is so urgent—

that the Office of Price Administration has distributed a folder to all local ration boards stating, "It is essential that every Burner and every Stoker now heating or being installed to heat all classes of large buildings be equipped with full automatic controls operating from outside temperatures."

No priority is needed—

to purchase such "Outside" controls. We have been allocated materials by WPB for construction of Marsh Tri-trol Regulators to make them immediately available.

Help the war effort and help yourself with the MARSH



TRI-TROL Regulator

that offers building owners and operators such "Outside" control in its simplest, yet most complete form. It is easily installed, fits any type or size of building and usually saves enough to pay its own way the very first year. AND EACH SALE PAYS YOU A BIG PROFIT.

Uncle Sam wants action RIGHT NOW. We have been permitted to reproduce the OPA folder . . . you can send this important message to all of your customers. Copies are ready for you, along with a complete money making and fuel saving program.

Write for all the facts. DO IT NOW!

MARSH TRITROL COMPANY

600 S. MICHIGAN AVENUE • CHICAGO, ILLINOIS